Skyways FOR BUSINESS

OCTOBER 1956

National Business Aircraft Association Official Publication

Dallas Airmotive Salutes the NBAA

Dallas Airmotive is pleased to salute the National Business Aircraft Association on the occasion of its Ninth Annual Forum to be held in Miami October 23-25. As the engine overhaul agency for many members of the NBAA, Dallas Airmotive is proud to be a member of this progressive and outstanding organization.

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now hear this . . .

PERSONNEL

William Kloepfer, Jr., was appointed chief of CAB's Office of Congressional Liaison and Public Information.

Norman E. Eggers was appointed Assistant Manager of Commercial Aircraft Sales of the Allison Div. of General Motors.

Haydn R. Jones was named comptroller of Eclipse-Pioneer Div. of Bendix Aviation.

Burns R. Maus was appointed to the newly created position of Aviation Sales Manager of Champion Spark Plug Co.

H. A. Todd and **Robert P. Brooks, Jr.,** have been elected to the Board of Directors of Continental Aviation and Engrg. Corp.

Thomas J. May was named supervisor of the Engineering Analysis Group of Weber Aircraft Corp. **Sol W. Voorhes** is Weber's new Director of Commercial Sales, and **C. E. Helmstadt** is new Plant Superintendent.

Michael J. Phillips was named chief engineer for Nasco, Inc., distributor for Bendix Ultrasonic components cleaner.

Raymond R. Phillips has been appointed Plant Superintendent for Kellett Aircraft Corp., Camden.

John F. Taggert was appointed Manager of Fairchild Aircraft's St. Augustine branch.

Douglas Hembrough, who assisted in developing the Bendix Polar Path compass and was responsible for prototype installation of Automatic Flight Control System in the Vickers Viscount, has become Eastern Regional Manager of Pacific Scientific Co.

Rear Admiral Robert G. Armstrong, USN Ret., has joined AOPA, will perform liaison work on behalf of civil aviation with government agencies and the military.

K. F. Umpleby is new assistant to the General Manager of York Div. of Bendix, and **W. H. Sims** was named Chief Engineer. York manufactures subminiature electronic equipment.

Ralph A. Lamm is now Director of Engineering for Pacific Div. of Bendix.

Stephen F. Keating, Vice President of the Aeronautical Div., Minneapolis-Honeywell Regulator Co., has been elected Vice President of the company. Keating will continue as President of Aeronautical Div.. to which **Melvin P. Fedders** was elected Vice President.

Marcus J. Eliason was appointed General Sales Manager of Air Associates, Inc.

LaMotte Cohu was elected Member of the Board of Directors of Garrett Corp.

Donald A. Foley is new Aviation Sales Engineer for AC Spark Plug Div., G.M. Corp.

Ray Patten was named Industrial Relations Manager of Hycon Mfg. Co., Pasadena.

W. T. van der Nuell, formerly in charge of engineering for Garrett Corp.'s AiResearch Industrial Div., was appointed Assistant Chief Engineer, Turbomachinery Planning, for the entire corporation.

Leonard Goland was appointed Director of Research for Kellett Aircraft Corp.

Robert L. Kunzig has retired as Legal Adviser and Assistant to the Chairman of CAB.

Louis J. Springer was appointed Assistant to the Executive Vice President of Airwork Corp., Millville, N.J. He will continue as Comptroller of the company.

Henry J. Hamm, formerly Commercial and International Sales Manager of LearCal Div., Santa Monica, has resigned to enter private practice as sales management consultant. The new firm, Henry J. Hamm & Associates, will specialize in sales management, programming, training and promotion.

Clyde L. Councilman was appointed Chief Engineer of Air Associates, Inc.

Victor J. Kayne, air traffic control expert, has joined the AOPA staff as consultant.

Duane O. Wood was elected to the Board of Directors of Hycon Aerial Surveys, aerial mapping division of Hycon Mfg. Co. Wood will continue as Executive Vice President.

Carl M. Bullock was named Office Manager for Brown Aero Corp., Dallas distributor for Aero Commander and Lycoming engines.

C. Wickham Skinner is new Director of Administration for Minneapolis-Honeywell's new Aeronautical Div. plant near St. Petersburg, Fla.

HONORS

C. J. Reese, President of Continental Motors, received recognition for "outstanding contribution to agricultural flying" at the 1956 convention of Flying Farmers.

COMPANIES

Hamilton-Standard Div. of United Aircraft has established a new electronics department, supervised by George I. Willis.

Airwork Corp., Millville, N.J., has opened a branch in Cleveland, to be managed by Robert Scott and Boyd Gillen. The new branch will serve Ohio, Michigan, Kentucky, Indiana, and parts of W. Virginia and Pennsylvania.

Aeroquip Corp., Jackson, Mich.. has acquired General Logistics Corp., Pasadena, which designs and manufactures load control and tie-down equipment for aircraft and trucks.

Minneapolis - Honeywell Regulator Co. has purchased the Hathaway Plant in Boston prior to the removal of the Transistor Div. from Minneapolis to Boston, where it will combine with the Doelcam Div.

Sylvania Electric Products, Inc., has opened a new plant at Hillsboro, N.H., for the manufacture of transistors and diodes.

Lear, Inc., announced the appointment of the Norman Larson Co., Van Nuys, Cal., as distributor of Lear equipment and accessories.

OCTOBER, 1956

Skyways FOR BUSINESS

The official publication of the National Business Aircraft Association

COVER by Willis E. Bishop

FOUNDED BY J. FRED HENRY, 1942

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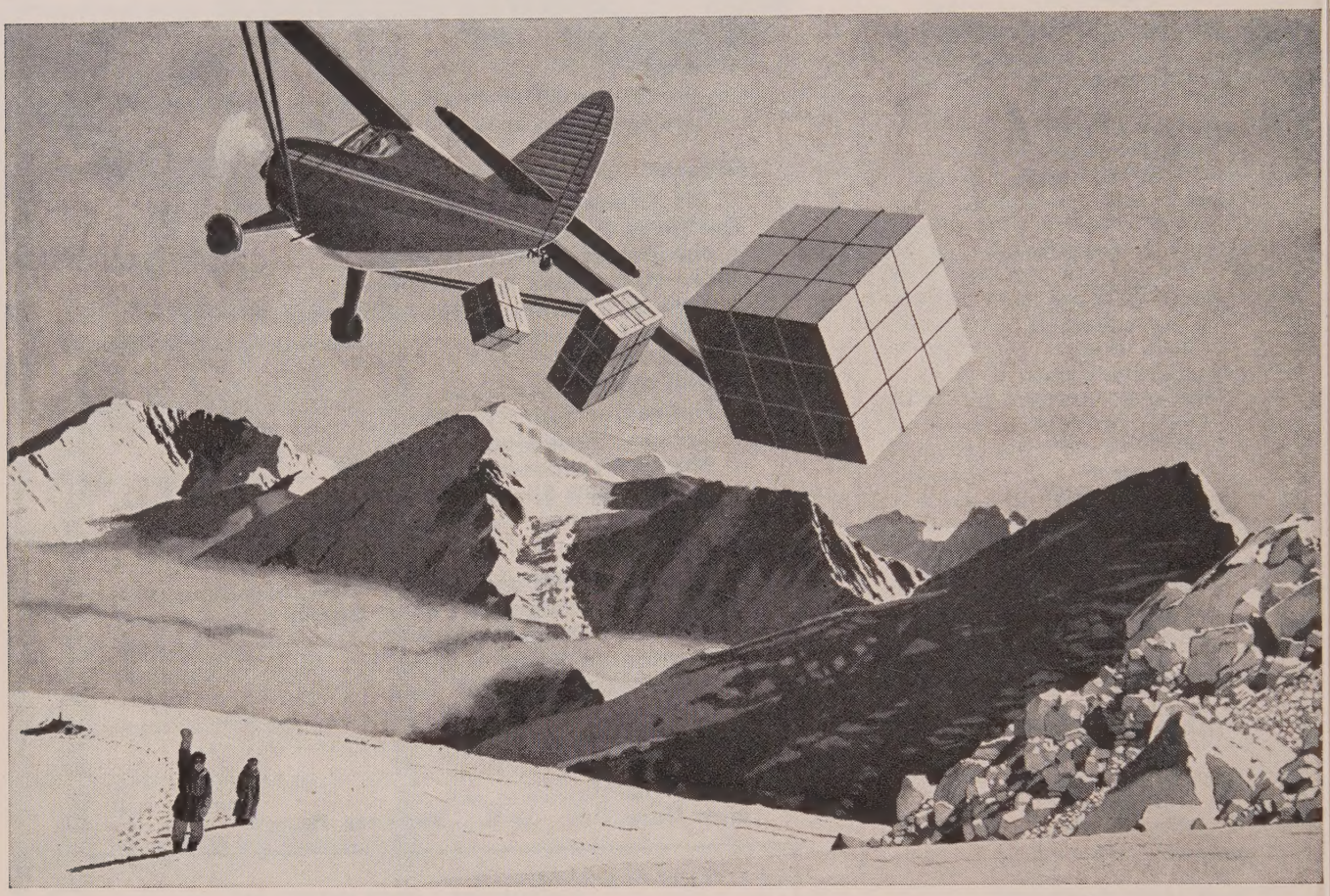
PLANE FAX

by STANDARD OIL COMPANY OF CALIFORNIA



Delivering groceries to the Sierra crest

Snowbound in June! Every year from November to the first days of summer, a snow-survey engineer and his wife are isolated in their home high in the mountains south of Lake Tahoe. And each month Max Jones, a grocer of Gardnerville, Nevada, flies over the Sierra Nevada's crest to drop fresh vegetables, meat and mail into the soft snowdrifts piled near their door.

"Much of the trip is low-level flying," says Mr. Jones. "In spite of going over the top at 10,000 feet I don't have much room to spare. But even in a downdraft I get all the power I need with Chevron Aviation Gasoline 80/87 in our Stinson's Lycoming. Chevron 80/87 gives me performance to spare when I'm climbing, yet I can lean down for real economy in level flight. Burns clean, too; never fouls plugs.

"Flying over this kind of rugged wilderness calls for a really dependable engine. Ours has 500 hours on it now, and RPM Aviation Oils have kept it good as new. Compression is still up to factory standards. It's never missed a beat, always runs smooth as a watch. All the years I've flown, I've never had engine trouble using 'RPM'."

TIP OF THE MONTH

Downdrafts are often violent near the top of a mountain range. Mr. Jones advises flying on the windward side of any ridge or pinnacle; then you can turn upwind if you hit a pocket.

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T.M.'S "RPM," "CHEVRON," "PLANE FAX," REG. U. S. PAT. OFF.

Editorial

THE GREEN CROSS AND AVIATION SAFETY

For years, the National Safety Council has sponsored annual awards of certificates to domestic airline operators for non-fatal airline operations. At almost any airline passenger counter these safety certificates may be seen on display.

There can be little question but that these National Safety Council "Green Cross" Certificates have contributed to public confidence in the safety of air travel, and have played a part in motivating a higher degree of attention to safety by the airlines.

Until now, NSC Airline Certificates have been based on "Passenger Miles," and given for operations with no fatalities.

However much good these certificates may have done, they are not representative of a uniform yardstick designed to establish facts and to encourage the utmost attention to safety. For instance, "Passenger Miles" seems a poor criterion for exposure to hazard. "Airplane Miles Flown" makes a much better yardstick to measure exposure to hazard. In addition, basing a safety certificate on "fatalities" only is tantamount to awarding Lady Luck. Consequences of accidents, the degree of severity, such as fatality, have no particular relationship to accidental occurrence:

> Two similar accidents may occur from a similar preventable cause, one resulting in fatalities and the other resulting in no human injury at all. The thing to be measured is the accidental occurrence. Each such occurrence has a cause and quite often an uncontrollable severity; causes can be analyzed, and, once analyzed, proper preventive measures can be undertaken.

In all other forms of safety award, the National Safety Council measures accident "frequency" (occurrence) by a uniform yardstick, and it also measures "severity" (the result, such as fatality) by a uniform yardstick. The NSC Green Cross for Safety should be used in aviation the same way it is used in American industry. Its criteria and its rules should be readily comparable to the criteria and rules governing the safety awards for any type of accidental occurrence.

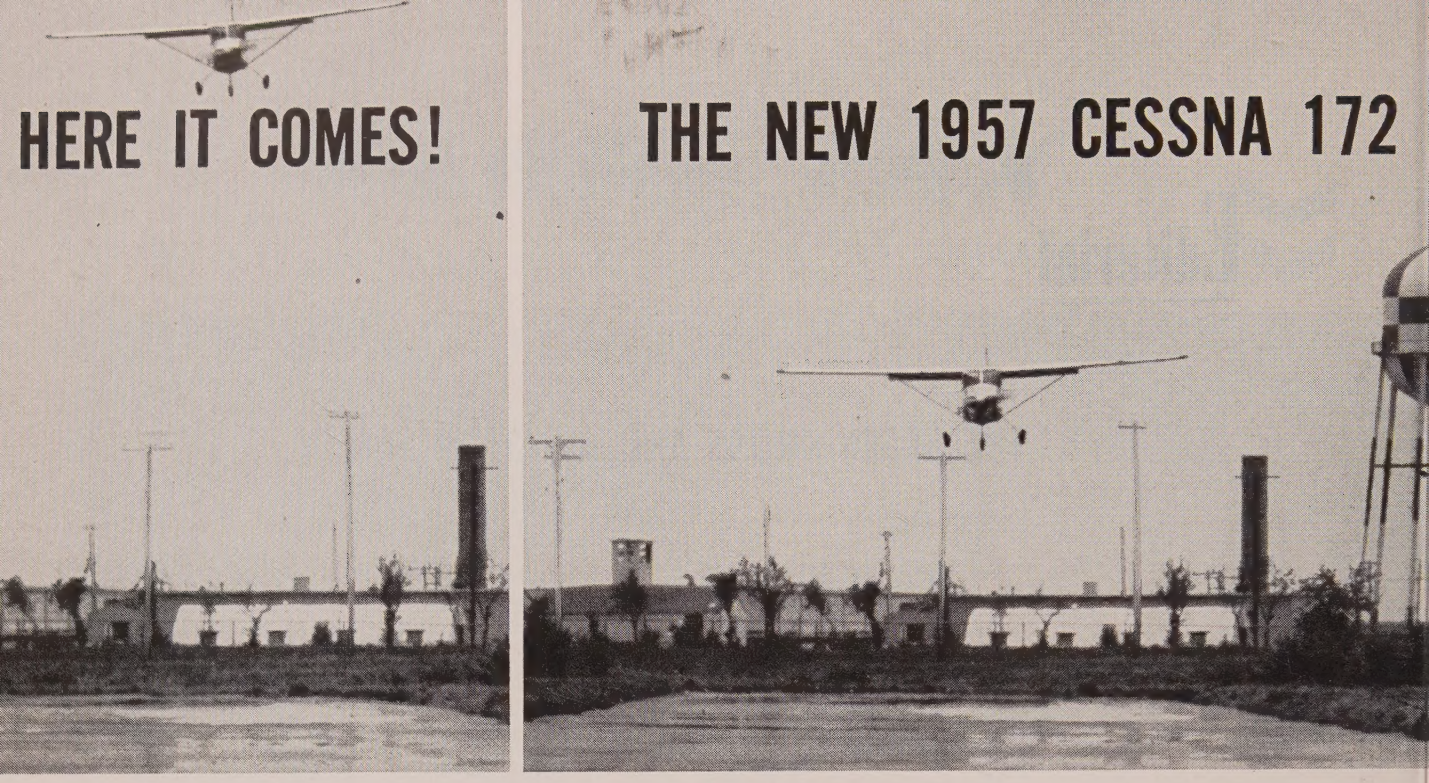
Aviation is growing up; its safety record is good. It is unfortunate that the yardstick for measuring its record has not yet been properly established. It should be established for all segments of aviation: military, airlines, business, flying farmers, flying doctors and other segments of private aviation. NBAA is proud of its past sponsorship of Pilot and Member Company Safety Awards. Its rules are indeed strict; its certificates carry respect; it gives certificates based on "Plane Miles Flown," a proper exposure to hazard, and *only* for operations resulting in *no injury, nor property damage of any kind.*

NBAA sincerely feels that uniform rules for safety awards is the business of the National Safety Council, and has so recommended to that organization. It would like to be able to compare its safety record with all other segments of aviation. It believes that such comparison would lead to greater safety efforts throughout the industry. NBAA does not hope to get the National Safety Council to adopt rules and regulations as those it espouses, but it does hope to be helpful in establishing uniform criteria and rules that will lead not only to establishing the factual record of aviation safety, but moreover to encourage more attention to safety in the operation of aircraft of all kinds.

NBAA is presently represented by its President on a National Safety Council Committee which is charged with the responsibility of formulating appropriate rules to govern contests, to measure safety efforts, to determine accident causes and to encourage greater safety activities throughout the field of aviation.

HERE IT COMES!

THE NEW 1957 CESSNA 172



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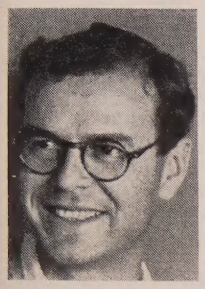
The Three Patriarchs and the 11 Aircraft



F. H. Steward,
President,
Steward-Davis, Inc.

It seems that a few years ago there were three world-renowned aeronautical engineers. They were very highly respected—veritable Patriarchs of their profession. They became upset over the readiness with which farfetched rumors regarding aircraft performance are accepted. Having mischievous senses of humor, they decided upon a plan that would prove their opinions on this subject and also, perhaps, prod a few people into more exacting methods of evaluating aircraft performance.

Shortly thereafter one of them "leaked" the information that they had come upon a remarkable but elementary aerodynamic discovery through which, for a preposterously small sum, they could add 5% more cruising speed to any large aircraft.

There was soon a waiting list of aircraft owners ready to have the Patriarchs modify their aircraft in accordance with the new discovery. The Patriarchs announced that they would personally supervise modifications on the first eleven aircraft. They proceeded as follows:

In the presence of the crew, three workmen, directed by "The Venerable Three", applied giant calipers to all parts of the aircraft, taking dozens of apparently very precise measurements. One of the Patriarchs recorded this data by puching buttons on an impressive electric computer.

All three of the Patriarchs then set up an animated conversation, with much swishing of slide rules, clattering of computer, and shouting of incantations to each other about "binomial integrators", "kinetic viscosities", "exponentiated modifications of compressible fluids", and so on.

At this point, the crew, somewhat skeptical but awed, was asked to leave and return in three days. Then the hangar was closed tight, and for the next three days nothing stirred.

At noon of the third day, the crew arrived, and the aircraft was released for test flight. The crews were uniformly pleased with the results of these test flights. There was no question that these modified aircraft had become faster, safer, easier to fly and cheaper to operate, thanks to the remarkable discovery of the Three Patriarchs.

Just as the eleventh airplane was to be delivered, the spokesmen for the Patriarchs announced that their discovery was too priceless to incorporate on anything but military aircraft, and the program would have to be cancelled.

Now that the glow of association with the Three Patriarchs has worn off, several crews have begun wondering about exactly what their aircraft did receive from the program. In fact, it is widely rumored in the industry that whenever some of these crews chance to meet, nothing but loud arguments ensue regarding whether the Three Patriarchs were charlatans or geniuses.

I have repeated the tale of the Three Patriarchs because it highlights four important points:

1. First, there is no question that small and relatively simple modifications to aircraft actually can result in significant performance gains.

2. Significant performance gains are often very difficult to detect and define exactly. For example, if you test-flew a DC-3 or even a DC-7 in the morning and then again in the afternoon with modifications giving an honest 3% gain in cruising speed, you could not be absolutely certain whether there had been a gain or loss in performance. There would be too many other variables involved.

3. Few operators have engineering departments at their beck and call. Therefore, they must become better informed on aerodynamics and aeronautical engineering in order to evaluate the many proposals they must consider for modernization of their aircraft.

4. Most operators do not demand from their vendors and their vendors rarely supply logical, well organized and verifiable presentations of their engineering data on proposed aircraft modifications. Also, operators should insist that when presented with a list of performance figures from the test flights of a given modified airplane, they should also be shown performance figures for the same airplane before it was modified while operating under identical conditions. This is the only way they can clearly evaluate the percentages of performance gain available from that modification.

Does this mean that an operator must employ an engineer to evaluate every modification? I don't believe that it does. I believe that the most helpful aid to an operator in such situations would be a check list for identifying and evaluating each separate element of a given modification package. I propose to submit to you a general outline of how such a check list should be drawn up for analyzing performance benefits.

First, however, it would be interesting to review the history of these problems, to see how they came upon us.

Only a few years ago, in even relatively small airlines, the engineering load was carried by several engineers, who specialized in such things as power-plant maintenance engineering, airframe maintenance engineering, new equipment development engineering, and so on.

But times have changed, and where there were once very few organizations in the entire world operating the larger aircraft, there are now about 800 private organizations in North America alone, all using Lodestars or larger aircraft. The majority has only one aircraft of that size, and the total operations flight staff invariably consists of one pilot and one co-pilot-mechanic, and no more.

Thus in the majority of our present day flight operations, two men are expected to be able to understand, evaluate, and select the correct equipment and modifications for their particular organization from among the flood of new services and developments rising out of our industry. They have little choice but to draw upon vendors for assistance in many of these realms in order to attend to their more basic duties. However, many vendors have tried to embrace too many functions with too few personnel. They have not

been able to provide operators with as much documentation as they need, while tending to be rather biased in evaluating services and products.

In the final analysis, an operator can protect the interests of his company only by increasing and diversifying his knowledge of aviation engineering. He must develop his own resources for checking his vendor's presentations and for comparing one vendor's data with that of other vendors. The checklist outline presented here should help greatly.

The first step in drawing up this check list is to segregate each separate element of any given modification package into three basic categories, according to whether it affects the aircraft's **Thrust, Drag, or Weight. A fourth category** will show the final effect on the aircraft's performance when the individual effects on Thrust, Drag and Weight are combined. The combination is important because if, for example, you increase Thrust and decrease Drag, but increase Weight, the increased weight will nullify the other gains and cause a net loss in performance.

Here is how the method was applied and how it could be used by an operator if he were to make a study of several alternate power-plants for use on his DC-3. First, he must recognize the three major sub-categories contributing to Thrust: Engine, Propellers, and Exhaust Stacks.

His first check list would be of each alternative engine which might be installed on his DC-3, including the present R-1830-92. He would then plot the following characteristics as approved for this DC-3: dry weight, take-off horsepower in low blower (and high if available), METO horsepower in both blowers, maximum cruising power in both blowers (defined here as 66⅔% of METO), average cruising power in both blowers (defined here as 55% of METO), critical altitudes for each of these power conditions, crankshaft RPM for each power, prop shaft RPM at each power, and specific fuel consumption for each power. This data would be compiled on graphs to highlight the differences between the engines.

Next, in running up his Thrust check list, the operator would list each alternate propeller he wishes to consider for each alternate engine. He would record the types of blades and hubs plus the weight of each different complete assembly. Then he would summarize the propeller efficiency factors for each propeller as installed on each engine. It would be best to obtain these efficiency factors from a vendor or from the propeller manufacturer.

Propellers provide thrust in about the same way as wings lift. If you put too much load (in this case engine horsepower) on them at too low a speed, they stall.

The standard DC-3 engine-propeller combination is the 1200-hp R-1830-92 with 6353A-18 propeller blades. This is a remarkably good combination, and in fact surpasses in the low-speed ranges the highly-developed propellers used on the latest DC-7's in terms of pounds of thrust delivered per horsepower. Trying to put any more horsepower into this propeller is likely to give diminishing returns, unless you increased its speed or lengthened the blades. The latter choice is impossible because the 6353A-18 blade is as large in diameter as can be installed on a DC-3.

Thus if an operator wished to install a more powerful engine on his DC-3 that would equal the standard -92 installation for pounds of thrust delivered per horsepower, he could still use the standard "toothpick" propeller, provided he turned it faster. A more powerful engine that turned the prop more slowly, such as the R2000, would overload the propeller, and you would have to seek another model propeller with wider blades to absorb the greater horsepower.

TABLE 1

Engine	*Propeller*	*Prop RPM @ TO- Power*	*T-O Brake HP*
R1830-92	6353A-18	1520	1200
R1830-94	6353A-18	1575	1350
R2000-D5	6863A-1	1350	1450

TABLE 2

Engine	*Propeller*	*Lb. Thrust/ Brake HP*	*Total Thrust @ "0" MPH*
R1830-92	6353A-18	3.5	4210
R1830-94	6353A-18	3.33	4490
R2000-D5	6863A-1	2.8	4065

TABLE 3

Engine	*Propeller*	*Lb. Thrust/ Brake HP*	*Total Thrust @ 60 MPH*
R1830-92	6353A-18	2.98	3580
R1830-94	6353A-18	2.83	3845
R2000-D5	6863A-1	2.54	3690

TABLE 4

Engine	*Propeller*	*Lb. Thrust/ Brake HP*	*Total Thrust @ 96.8 MPH (V_2)*
R1830-92	6353A-18	2.7	3230
R1830-94	6353A-18	2.66	3590
R2000-D5	6863A-1	2.5	3615

Thus it is evident that the choice of alternate engines and propellers for modifying any given airplane involves many compromises because, short of expending tremendous sums for engineering entirely new components, one must try to modernize with components that are already available and licenseable on the aircraft.

To illustrate the effect that such compromises can have, and to continue the illustration of how an operator would use the check list evaluation technique to establish comparative data, consider the take-off performance of three widely recognized alternate engine-propeller combinations for the DC-3 (Table 1). At the instant of starting take-off, with airspeed at "0" mph, each engine with its propeller would deliver thrust as in Table 2. At 60 mph each engine-propeller combination would deliver thrust as in Table 3. At V_2 speed, 96.8 mph, each engine-propeller combination would deliver thrust as in Table 4.

Notice that in each of these cases the 6353A-18 propeller delivers slightly less thrust per horsepower when it must absorb 1350 hp than when absorbing 1200 hp. This indicates that the extra 150 hp is slightly overloading it. Notice too that the R2000 puts out less thrust per brake horsepower than either of the other engines throughout take-off, and that at V_2 speed on the DC-3 the 1450 hp of the R2000 is approximately equal to the 1350 hp of the -94 in terms of total thrust delivered.

The same calculations and graphs should be prepared for the Thrust performance of engine-propeller combinations at METO and cruising powers for the appropriate speeds and altitudes.

This completes the checklisting of engines, propellers, and combinations. The last sub-category under Thrust is then "Exhaust Stacks".

The best energy recovery currently achieved is about .18 pounds thrust per brake horsepower of the engine. If you normally cruise at 10,000 feet in a DC-3 using 600 hp per engine at 185 mph, this optimum exhaust recovery will contribute as much to increased speed as 60 additional brake hp on each engine. Thus with an ideal exhaust system you could increase your speed from 185 to about 192 mph.

The proper design of exhaust systems is a delicate job. In the evaluation of "Exhaust Stacks" on his checklist, an operator is particularly de-

(*Continued on page* 34)

Featherweight Champ!

ARC's ADF weighs less than 20 lbs!

Why carry dead weight? Why excess bulk?

This Automatic Direction Finder offers accuracy and reliability proved in more than two years of testing – yet the entire 5-unit system weighs only 19.7 pounds. Now you can have a DUAL installation where required – at a weight saving of 80 pounds or more.

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Omni/ILS Receivers • Course Directors • UHF and VHF Receivers and Transmitters LF Receivers and Loop Direction Finders • 10-Channel Isolation Amplifiers • 8-Watt Audio Amplifiers • Interphone Amplifiers • Omnirange Signal Generators and Standard Course Checkers • 900-2100 Mc Signal Generators

SKYWAYS FLIGHT OPERATIONS ROUND TABLE

OCTOBER 1956 *Washington, D.C.*

Jato as a Safety Factor in Business Aircraft

Panel discusses experiences with Jato, its advantages and potential for future development, and comments on some of these characteristics:

- **C.A.A. certificated standby rocket engines now available for larger business aircraft; Junior Jato on its way.**
- **Eleven business installations flying, fourteen in process, and seventy more planning.**
- **C.A.A. policy permits gross weight increases to cover installed weight of Jato on aircraft.**
- **Instantaneous thrust on demand for protection throughout flight. Jato valuable en route and in landing as well as for take-off.**
- **Latest Jato has no smoke- or noise-nuisance.**
- **Costs 2% to 3% of airplane value for initial installation; costs ½% to 1½% of plane value annually to carry Jato.**

Burleigh Putnam, Moderator *(Chief, General Safety Division, CAA):* *"Jato is a term we've all been hearing for a good many years, and I doubt if there are very many people who really know the extent to which Jato units are being used, how they're made, and so on. Jato has been used as a standby thrust medium by a few business aircraft operators since 1949. With the coming availability of Jato units with improved characteristics for standby application, there has been considerable interest in business aircraft installations. I have asked Mr. Rice if he would tell us a little about the manufacture of these rocket engines, what the name Jato stands for, etc."*

G. E. Rice *(Manager, Commercial Jato Sales, Aerojet General Corp.):* "The name "Jato" stands for "Jet-Assisted Take-Off," but this is something of a misnomer for the application which we are discussing, which is the use of Jato as standby rocket thrust.

"Solid propellant Jatos are being manufactured for military use by Aerojet General Corporation, Allegheny Ballistics Laboratory, Grand Central Rocket Division, and Phillips Petroleum Rocket Division. There are also several manufacturers of liquid propellant rocket engines, including some of those just mentioned, but it is believed that the standby usage will be confined to solid rocket units for the immediate future because of their simplicity, reliability and low maintenance requirements.

"To date, application has been made and CAA certification has been received on only one of the currently manufactured aircraft rocket engines, the Aerojet General 15KS-1000-A1 smokeless rocket engine. However, it is understood that some of the other manufacturers are considering certification for some of their products, and Aerojet has under development a smaller unit for lighter aircraft, which should be certificated early next year. This small unit will deliver 250 pounds thrust, or about 100 hp, and will be applicable to airplanes from the Cub class to the Twin-Beech class."

Putnam: *"Captain Domning, we have heard about some of the Jato applications in the high altitudes of South America, and I think the airlines down there are going to do some additional work with rocket thrust. Would you like to give your views on the need for this supplemental thrust, particularly with regard to altitude and high temperatures."*

Loyal Domning *(Technical Chief Pilot, Panagra):* "We received CAA authorization for the use of Jato on our DC-4's in operation from La Paz, Bolivia, in 1950. The elevation of that airport is 13,400 feet above sea level, with an average ambient temperature of 50° F. above standard, resulting in density altitudes between 16 and 17,000 feet. The engine and aircraft performance will suffer a good deal under these conditions. Since, as a rule, aircraft manufactured to date are designed to operate from airports below 8000 feet, the special problems that we have at these high airports have not been met by basic aircraft.

"The only way that we were able to make the DC-4 an economical airplane for that operation was to add thrust in some manner, and the only device available for adding this thrust was Jato. We installed the units, tested them very thoroughly, instituted a complete pilot training program, and enjoyed complete success. Not only were we happy with it from the technical aspect, but the company was happy with it from the economic aspect, and the pilots were happy with it because the airplane behaved very well with the Jato units attached. We now have another proposal before the Civil Aeronautics Board which would, if approved, authorize the use of Jato on our DC-6B and DC-7B airplanes at the same airport."

Putnam: *"Col. Estelle, has your company used them at all?"*

W. W. Estelle *(Aviation Manager and Chief Pilot, Esso Shipping Company):* "Yes, we have been using Jato on our DC-3's for about six years. In the past three months, we have engineered and installed them on our Convair 240 with great success.

"With the DC-3, we used them on take-offs in Costa Rica, where it would require the complete field for take-off. The field was about 3000 feet long, and at an altitude of 3000 feet. We could, with the use of two Jatos, get off in half the field, or about 1500 feet. We'd be at least two or three hundred feet in the air at the end of the field. With the Convair, we were taking off in Colorado at a turf airstrip which is 6200 feet high, with a density altitude of 8000

feet. Here we used only 68% of the runway with four Jatos sequenced in pairs. We have six installed. The only experience we've had so far is with Convair and DC-3."

Rice: "In addition to high-altitude operations with Jato, another type of application is developing very rapidly. This is a standby thrust application to give protection throughout the flight. A typical example of this in the take-off regime are three instances of usage in the South American operations at La Paz. These three cases did not involve the condition for which the Jato was originally installed, which was to cover the problem which might exist should engine failure occur between V_1 and the 50-foot obstacle clearance. In one case, the pilot encountered freshly drifted snow which the airport personnel were not aware of, and which reduced his acceleration to a critical point. In another case there was a wind-shift during the take-off, creating marginal conditions. In the third case, there was an engine failure at about 100 feet altitude, and simultaneously the pilot encountered some turbulence which reduced his speed to marginal. In all cases Jato was utilized to accelerate into a safe speed range. Am I correct on this, Captain Domning?"

Domning: "The first instance you mentioned must have been with another operator. I'm not familiar with it; but I know the other two did happen."

Rice: "Yes, the first instance was in Braniff's operations. These are introduced only as actual incidents where Jato put an airplane into a safe condition which would otherwise have been marginal. Going on with this, we have recently made a survey of the accidents that have occurred in flight between the start of the takeoff and the end of the landing run. In our review of accidents in Executive and Air Carrier flying, we have made several hundred individual contacts with accident-investigation personnel of the CAA, the CAB, the ALPA, several corporations and several individual airlines to be sure that we had correct information regarding the circumstances surrounding the accidents. We have made a careful study of the CAA accident reports covering fatal executive flying accidents from 1949 through 1955, and substantial damage and fatal air carrier accidents in 1954 and 1955. While I have personally been a pilot and aircraft engineer for over twenty years, I preferred not to trust my own judgment, because of my enthusiasm for standby rocket thrust. I checked each situation carefully with several executive and airline pilots of over twenty years experience. This has resulted in the deletion of some accidents which we thought might have been prevented, and the addition of others. Here are the results:

"In the executive field there have been 27 fatal accidents involving 121 fatalities in the period from 1949 through 1954. Of these, it appears that 13, or 48%, could have been prevented or reduced in seriousness by additional thrust at the critical point.

"Of the total fatal accidents, 6 accidents (or 22%), occurred in take-off, 14 accidents (or 52%) occurred en route, and 7 accidents (or 26%) occurred in landing. Additional thrust might have prevented 83%, or 5 out of the 6 take-off accidents, 29%, or 4 out of the 14 en route accidents, and 57%, or 4 out of the 7 landing accidents.

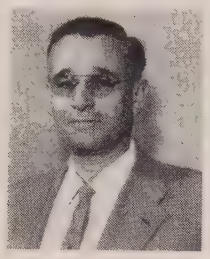
"The fatal air carrier accidents during 1954 and 1955 also follow the same pattern rather closely. Of the 20 fatal accidents in this period, 15% occurred in take-off, 60% occurred en route, and 25% occurred in landing. In the air carrier field, 100% of the take-off accidents, 25% of the en route accidents, and 60% of the landing accidents might have been prevented or reduced in seriousness by additional thrust.

"We cite these statistics to emphasize that, contrary to general belief, and contrary to our own past thinking, this standby thrust medium offers protection throughout the flight, rather than being solely an assist-take-off unit. Actually, undershooting on landing is the largest single source of accidents

BURLEIGH PUTNAM *(Center) and Col. Estelle discuss with G. E. Rice (back to camera) the alternatives of nacelle and fuselage mounting of Jato, and its effects on flight characteristics. Frank Dolinski (l) reported no disadvantage in nacelle mounting. Capt. Loyal Donning described Panagra's Jato experiments from high altitude airports in South America. Gilbert DeVore commented on drag-load of externally mounted Jato units.*

ROUND TABLE PARTICIPANTS *(left to right): Frank J. Dolinski, Aerojet General Corporation; Loyal Donning, Pan American Grace Airways; Gilbert DeVore, DeVore Engineering Service; Burleigh Putnam, Chief, General Safety Division, C.A.A., Moderator; Col. E. W. Estelle, Esso Shipping Company; E. J. Swearingen, Howard Aero, Inc.; and G. E. Rice, Aerojet General Corp.*

ROUND TABLE PARTICIPANTS



BURLEIGH PUTNAM, Moderator, is Chief of CAA General Safety Div. Has been flying since 1929; pilot and instructor, 1932-36; Aeronautical Inspector, Bureau of Air Commerce (CAA) 1937; Chief, Aviation Safety Div., Region 8, 1941-52.

GILBERT DEVORE, President of DeVore Engineering Service, has worked in aircraft design for Curtiss-Wright, Bristol Aircraft Div., and Fairchild Personal Planes Div. Flight research for NACA; flight test engineer, 7 years, CAA. Member IAS, AHS, Wings Club.

FRANK J. DOLINSKI, Chief Pilot for Aerojet General Corp., has been flying since 1937; flight instructor, Spartan School; test pilot, Consolidated Aircraft, 1942; ATC Pacific Theatre; KLM pilot, corporate pilot since 1948.

LOYAL DOMNING, Technical Chief Pilot for Pan-American Grace Airways, was Naval carrier pilot until 1939; airline pilot since 1939. Made original Jato tests for Panagra in 1950.

E. W. ESTELLE, Aviation Manager and Chief Pilot for Esso Shipping Co., has been with Esso and its affiliates for 24 years; served in both wars, the second in the CBI and Pacific Theatres.

G. E. RICE, Manager of Commercial Jato Sales for Aerojet General Corp., has been a pilot for 20 years; has served in engineering or sales positions with Stinson, Hiller, and between 1933 and 1944 was aircraft engineer or production manager for various major aircraft manufacturers.

E. J. SWEARINGEN, Executive Vice President of Howard Aero, Inc., has been associated with Howard since 1947 except for 18 months with Lear, in development of the Learstar and Arcon. At Howard he supervised engineering of Super Ventura.

in both civilian and military flying. These are not as a result of mechanical or power failure alone, but also from windshifts, downdrafts, ice loads, etc. Additional thrust could provide the necessary climb to prevent many of these."

Gilbert DeVore *(President, DeVore Engineering Service):* "I would like to add to Mr. Rice's comments concerning these accident reports. We have discussed them at some length, and in analyzing the report, some landing accidents were discarded which on first impression would lead you to suspect that they could have been avoided by the use of Jato. However, further investigation was made concerning these accidents and, for example in two cases, the Mason City DC-3 accident and one involving a Convair in Chicago, it was determined that the pilot had not had time even to advance the throttles. Therefore, these were thrown out, since the pilot was not able to attempt a recovery. Another case, involving a Martin, in Albuquerque, was also discarded; however we feel that this accident might have been reduced in seriousness had Jato been available. I believe very much in the ability of Jato to avert or reduce in severity some of these fatal accidents which occur in landing."

Putnam: *"That would be a real contribution to safety. Perhaps Captain Domning would like to make a statement regarding the remarks that we've just made."*

Domning: "I can only say that in our consideration of the utility of Jato, we have always had an actual performance credit in mind. Rather than runway length problems or obstacle clearance problems, we have had the problem of lifting more payload from specific airports at high altitudes in high temperature conditions. We have approached these conditions with the idea of utilizing Jato thrust to meet the first segment and second segment climb requirements, and, in addition, to meet the landing requirement, which is a very critical matter when you get to high altitude and your power is reduced. We haven't gone into this thing with the idea that we are affecting safety one way or the other, because we can always have the same safety by reducing payload and operating with a lighter weight. We have found that from the economic aspect of operation Jato has filled the gap where nothing else would do."

Rice: "Perhaps, when you say that you can always have the same safety by off loading, you're overlooking the fact that when you have rocket engines aboard as standby thrust you have them available all the time, regardless of whether the aircraft is developing full power or not. Since all of your performance considerations are based on the critical engine-out condition, you definitely have this added safety through the periods when the most accidents occur. It has been our experience, from reviewing the accidents in recent years, that very few of them occur as a result of engine failure on take-off. So you do have this additional thrust available all through the flight to protect you even when you have all of the engines operating. And this is added safety."

Domning: "Much of what you say is perfectly true. However, as far as the landing maneuver is concerned, we have not felt that Jato makes anything like the degree of contribution that it makes in the take-off, because of the fact that, if the pilot is going to be in the position to recognize his performance deficiency, the first thing he's going to do is to apply his normal engine power. If he doesn't recognize this performance deficiency, he isn't going to do anything, and the Jato won't help him. Secondly, in his landing approach, if the pilot recognizes his performance deficiency, and adds engine power, and in addition to that applies Jato, it probably is going to mean that he will have to go around and make another attempt to land, because he can't shut the Jato off, and if it takes him out of the spot he's in, he's probably going to end up overshooting."

DeVore: "Mr. Domning's comments are very interesting, since they indicate that the full advantage and benefits of Jato are not completely realized. I should like to point out that we are talking about undershooting, which may occur as a result of the pilot's own flight path or as a result of the elements, and as a consequence produce a fatal accident. If Jato is armed for landing and the pilot calls for it, the co-pilot can fire Jato and have its maximum thrust available before the pilot can get the throttle open. It must be understood that the ability of an airplane to climb is a function of its excess thrust horsepower. Jato provides an important boost in excess thrust horsepower, thus giving the airplane a good rate of climb in a critical period. With full take-off power, a DC-6 would put out approximately 20,000 pounds of thrust. A two-bottle Jato firing would add 2000 pounds of thrust, which would better than double the excess thrust horsepower available for climb. As for making another go-around the field, obviously this is infinitely better than a fatal accident. However, it certainly will not always be necessary to make another go around the field. A DC-6, for example, in level flight at 125 mph, is probably pulling 4000 horsepower. This would be equivalent to approximately 8500 pounds of thrust. Since thrust equals drag in level flight, we would be adding only approximately a fourth of the thrust required for level flight with the addition of Jato. When the throttles are chopped, the Jato

(Continued on page 42)

THE BILL OF MATERIALS

By Willis L. Nye

It is probable that with the increase in the use of twin and multi-engine air transport planes for business, coupled with the current and prevalent shortage of this equipment, air-transport maintenance concerns will be required to accomplish considerable modification of these airplanes to bring them to the latest CAA requirements. Thus, mechanical as well as interior modifications will be in order and will require considerable engineering to comply with this program. In any modification operation on an air transport, be it one or a group of airplanes, the Bill of Materials covering the work is an essential engineering document for the organization performing the work as well as for the customer. Therefore, let us review some of the preliminary aspects of the Bills of Materials that will be required in order to perform modification work systematically at the lowest commensurate cost.

A Bill of Materials is defined as a systematically compiled list of raw materials, semi-finished parts or assemblies, finished fabricated parts, purchased parts, attaching parts, and other furnished equipment and components necessary to perform a specific modification. Usually, a Bill of Materials is presented on a printed form of some sort and is made in the sequence of assembly for parts with multiple components. The list of parts or materials may not necessarily take into consideration the number or quantity required per airplane, such quantities as required being derived from production planning orders. It may be made in a consolidated form or it may be segregated, depending on the kind of modification required or as required by the customer or his engineering representative. Parts or materials that require special action are noted appropriately. There is no standard set form for the compilation of a Bill of Materials, one form functioning as well as the other. It is also possible that a printed form not be used, the information for a Bill of Materials being contained on the engineering drawings covering the modification work.

Manufacturer:
QUANTITY: 1
ASSEMBLY UNIT: Landing Gear - Dwg. No. 10220

BILL OF MATERIALS
RAW STOCK

MODEL YO-50
Page No. 1 of 2 Pages
Date

MATERIAL		SIZE AND SPECIFICATIONS	Size Req'd (Max.)	WEIGHT EACH KIND (LBS)			FLOW (Weeks)
KIND	FORM			ROUGH	REJECTION	FINISHED	
Aluminum	Sheet	QQ-A-561 - Type 1-A .032" Ga. 2 SO		.01	-	.009	4
"	"	A.C. 11067-A Type 2 .020 Ga. 24 ST Heat Treated	48x48	6.98	.68	6.42	4
"	"	.040 Ga. " " " "		.77	.07	.72	4
"	Bar	QQ-A-354 1 1/4 RD 24 ST Heat Treated	36 in	2.75	.28	2.42	6
Brass	Sheet	E-QQ-B-611-A .025 Ga. Yellow Brass		.42	.04	.38	5
Bronze	Bar	QQ-B-666 A.B. 3 1/2 RD Al Bronze (Ambralay) American Brass Co.	12 in	10.92	1.09	9.8	6
Steel	Bar	3/4" RD. SAE X-4130 (57-107-19) Hot-Rolled Hardened Tempered	18 in	.07	.01	.06	6
"	"	7/8" RD. " " " " " " "	" "	6.0	.50	5.5	6
"	"	1 5/8" RD." " " " " " "	" "	1.30	.10	1.05	6
"	"	2 1/2" RD." " " " " " "	" "	2.08	.20	1.90	6
"	"	3" RD. " " " " " " "	" "	11.75	1.5	10.25	6
"	"	3 1/2" RD." " " " " " "	" "	10.87	1.09	9.5	6
"	Sheet	.049 Ga. X-4130 - Cold Drawn Heat Treated	14x36	1.42	.14	1.36	4
"	"	.065 Ga. " " " " "	" "	1.16	.10	.96	4
"	"	.095 Ga. " " " " "	" "	2.56	.26	2.40	4
"	"	.125 Ga. " " " " "	10x24	25.20	2.5	23.05	4
"	"	.156 Ga. " " " " "	" "	76.67	7.5	69.42	4
"	Tube	3/16" OD x .065 Ga. S.A.E. X-4130 Cold Drawn Heat Treated	48 in	.10	.01	.08	5
"	"	3/8" OD x .058 Ga. S.A.E. " " " " "	" "	.22	.02	.18	5
"	"	1/2" OD x .095 Ga. " " " " " "	" "	.40	.04	.36	5
"	"	3/4" OD x .035 Ga. " " " " " "	" "	.48	.05	.44	5

FIG. 1—*Raw stock B/M is compiled to show quantity of raw materials necessary to accomplish a specific modification. It also may include maintenance raw stock where overhaul is performed simultaneously. No consideration is shown for either waste or rework*

Several various kinds of B/M are used in air-transport modification, *i.e.*,

1. Raw Stock
2. Customer Furnished Parts.
3. Purchased Parts and Installed Components.

A ferrous and non-ferrous metal should be shown as castings, rolled or extruded; forged; ingot or billet stock; rod, bar, or tube; strip, sheet, or plate; wire or cable. Rubber materials should be shown as natural or synthetic. Solder as aluminum bar, lead and tin, silver tip, silver wire, spelter rod, or wire. This makes for easy identification.

Where possible, the processing materials should also be listed under finished weights and furnished as a separate group. This is to include the materials used in the manufacturing processes which are usually not part of the modification contract. The quantity may be obtained by dividing the quantity used over a period of time by airplane deliveries, or by comparison for a similar type. This data is useful in compilation of the accreted weight on the airplane after modification.

Preparation of the B/M There are certain well-defined rules to be followed in the preparation of the Bill of Materials. These are uniform throughout the industry and can be easily followed.

The model of the airplane is shown along with the license number and serial number in the case of an individual airplane undergoing modification.

When a purchased part is being broken down, the part number is shown in place of the model type.

Assemblies are shown as aileron assembly, elevator assembly, or left wing assembly, in that order of alphabetization. Installations such as equipment and furnishings, landing gear installation, etc., are to be shown in that manner.

The sizes indicated on the B/M for raw stock should be those ordinarily used in purchasing. Materials (raw stock) are listed by grades, alloys and numbers, etc., so that these may be readily identified and broken down into basic materials. Commercial or A-N specifications, tradenames or other descriptive methods should be used so that the material can be ordered from several vendors of the same product. In the instance of alloy steels, if required, these should be listed as plain hot rolled, annealed, pickled; rolled, normalized; hot rolled, rough finish; hot rolled, heat treated (quenched and drawn); cold drawn; cold rolled, annealed and pickled (sheet and strip) or cold rolled temper to hardness. This is essential information.

In the interest of weight control, the finished weight also can be shown by adding the finished weight of the individual weight of component parts. However, this is a refinement and ordinarily may not be done in air-transport modification.

The assembly quantity should be the total quantity of each part per assembly or installation.

The part number should be listed under that which a purchased part is procured. If an A-N number also is assigned to it, this should be shown parenthetically. Alternate sources of supply may be designated also.

In general, to assist the purchasing of material, all information for ordering and specifying the part should be included. It is important that the nomenclature be in accordance with the titles of the engineering drawings for modifications such as Cargo Bulkhead-Attaching bracket; Luggage Rack-divider partition, etc. Drawing numbers should be referenced.

Where fabricated parts are purchased, the vendor should be designated, along with other pertinent data.

Who Prepares the B/M Depending upon the size of the concern undertaking modification work, the Production Planning Section of the Engineering Department usually prepares the B/M from engineering drawings, service bulletins, project sketches, etc. In the smaller concerns this may be done by the engineer directly in charge of modification projects. The airplane manufacturer's parts catalogs and service bulletins provide a ready source of supply of breakdown information, part numbers, and assembly numbers. However, in the case of special modifications done locally by the company performing modification work, the B/M is listed on the engineering drawings or sketches along with the quantity per plane.

Normally, modification work comprises changing a passenger transport into a cargo plane or vice-versa, installation of a new interior, installation of new radio equipment or instrumentation, or new engine installation. From this it may be gathered that the B/M as applied to overhaul and modification is not as extensive as the manufacturing breakdown.

It is true such work can be done without a B/M but where contract cost is involved and where a quantity of airplanes is modified in a similar manner, the need for a complete B/M is apparent.

For example, on an air-transport modification project, what control does the customer have over a modification of his airplane unless he has access to a B/M which shows and designates the material to be used. When the B/M is available, he or his representative can inspect it, accept or veto the use of certain materials of his preference, and he can also be certain that the inspection of the final work will be in accord with the material on the B/M.

For the customer who has work performed on a time-and-material basis, the B/M works to his advantage as well as to the advantage of the organization performing the modification. It also shows the cost of the parts to be used and functions as a guide for the material quality. This document should become part of the airplane history to show what was incorporated into the structure during the life of the plane. Thus, by the judicious use of a B/M, the customer can exercise a reasonable control on parts installed in his airplane.

Airplane manufacturers usually include a B/M in any service bulletin that they prepare. This type of B/M is somewhat abbreviated but it does show the part number, description, and other detailed data. Where the service bulletin is in the category of a mandatory airworthiness directive, the parts to be removed or installed are listed in detail along with the quantity of parts to do the work. The B/M may or may not always include the quantity per plane but may refer to drawings from which it is possible to determine the parts per plane.

Control of Costs by the B/M On those projects where the modification operations may be done on a cost-plus or a negotiated-cost basis, documentary proof is the logical way to arrive at the final cost of this work. When the final costs of material are accounted and costed, it is necessary to determine the cost of parts, sub-assemblies, assemblies, and raw stock by means of the B/M which shows the quantity. Reference to current purchase orders cross-referenced against the B/M makes it easy to determine the landed cost at the maintenance base.

Another phase of the cost control is the referencing of production planning orders against the numbered B/M. Thus, the quantities of parts or material is known per airplane, and the production-planning orders required to perform various installations or overhaul operations. When these production planning orders are authenticated by licensed inspection personnel as being complete, then the actual shop cost may be arrived at for over-all cost purposes from which the fee paid to the contractor for the work is determined.

Where work is only partially completed and the balance may be deferred to a later date, such as a partial overhaul, the B/M permits the inspection personnel to determine accurately what work has been accomplished in the utilization of parts. From this, cost data can be determined.

Another function of the B/M form is to control the issue of parts or stock from the storeroom. It permits a closer inventory control when properly coordinated with accurate records and prevents pilfering and reissue of parts unknowingly against a specific project, which is always a factor to contend with in modification projects.

Summary By means of the B/M, it is possible for the air-maintenance organization to control the inventory, the procurement, and the scheduling of material in conformity to the delivery schedule of completion. It also is used as a guide to control the withdrawal of material from the stockroom to comply with the production-planning orders as well as to cost, material, etc. All of these functions could not be efficiently controlled unless the B/M method of controlling material is used. It provides a record form to obtain an audit of material that has been issued against a specific plane project. It also functions as a material installation guide for the customer. Thus, without good B/M control modification work may be performed, but not performed with a degree of control that is satisfactory where competitive contractural costs must be reckoned with.

In general, the B/M is one of the primary documents for all personnel concerned with modification work. It also functions as an inspection as well as an installation guide. The B/M provides historical data for the owner as to what was modified on the airplane to change the weight or fore-and-aft balance. Because modification work usually involves an increment in weight, it makes it possible to compute the weight and balance accurately within the limits of safety. Certainly all of these factors more than balance the factor of the effort and cost to prepare this data and make it in permanent form.

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Dept. EA-2,
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Or write: MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, Box 478, Dept. EA-2, St. Louis 1, Missouri.

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WHERE CREATIVE CHEMISTY WORKS WONDERS FOR YOU

New Bell 47-J Commercial Helicopter

BELL AIRCRAFT CORP. *announces CAA certification of the four-place 47J commercial helicopter, powered by 260 hp engine, top speed 110 mph, capacity 1000 pounds. The 47J Ranger combines the operational flexibility of rotary-wing craft with a convertible interior which adapts it to a wide variety of commercial and rescue operations.*

Bell 47J Ranger: Versatile New Commercial Helicopter

Bell Aircraft Corp., NBAA Associate Member, Fort Worth, Tex., has announced the addition of a new helicopter to its commercial line, the four-place single-rotor Model 47J. Called the "Ranger," the helicopter has received CAA type certificate 2H-1, and deliveries are expected early in 1957, according to Vice President Harvey Gaylord.

Currently in production for the Navy as the HUL-1, the new 47J is a versatile craft suitable for executive service, cargo, rescue, ambulance and long-range survey work.

As an executive aircraft, the 47J is available with a standard or a custom interior. In ambulance service a complete litter kit can be installed for two patients in five minutes. An electric hoist gear may be used for rescue operations, and a removable floor section enables the hoist to lift objects directly into the cabin. Range can be extended by using an auxiliary fuel supply.

The 47J is powered by a 260 hp Lycoming VO-435-21 engine, readily accessible for maintenance. The abundant power (the 47J uses only 220 of the available horsepower) extends periods between overhauls to 600 hours. The 47J has a useful load of 1017 pounds; normal fuel supply of 35 gallons gives a range of 175 miles. Hovering ceiling in ground effect is 8000 feet; service ceiling 15,000 feet; absolute ceiling 16,000 feet. At maximum gross, 2565 pounds, the 47J climbs from sea-level to 5000 feet in 7.5 minutes.

NEW BELL 47J *converts easily from this custom business interior to roomy cargo carrier, ambulance for two litter patients, or rescue unit with internal hoist which lifts objects directly into cabin.*

Flotation landing gear, night flying equipment, radio, heater and other accessories are to be certified for the Ranger.

The cabin arrangement is the result of extensive studies with businessmen and pilots. The pilot seat is forward of the center of the cabin, and a passenger seat, 60 inches wide, is located against the rear cabin wall, assuring privacy for executives and easy, unhindered operation for pilots if the 47J is used for cargo operations.

Supercharger for Helicopters Gives More Altitude, Better Climb

The practical business use of helicopters in survey work or for airlift operations in mountainous regions receives a boost from the McCulloch supercharger, which, installed on Hiller helicopters, provides significant increases in altitude performance by maintaining rated sea level horsepower up to 7800 feet.

The McCulloch supercharger, adapted from automobile-engineer installation, was installed on the Hiller 12-B and 12-C helicopters, and has been certified by the CAA. In addition to maintaining horsepower at altitude, the supercharger increased the hover ceiling of the Hiller helicopter to 8000 feet at maximum gross weight, the service ceiling to 13,000, and trial flights to 16,000 feet have been made. Rate-of-climb characteristics were improved, as well as performance in hot weather, and payload capacity.

In 75 hours of flight testing the supercharged helicopter is reported to have developed no important service difficulties.

Light Aircraft Exports for July

The Aircraft Industries Association has announced that exports of civil aircraft weighing 6000 pounds or less during July amounted to 65 units valued at $1,057,145, representing a unit increase of 30% over July 1955 and a value increase of 68.4%. The planes were sold by five manufacturers to 18 foreign countries, Alaska and Puerto Rico.

Principal market for American civil aircraft is Canada, which purchased 13 units. Next in descending order are Chile, which purchased 9 planes in July, the Union of South Africa, 8 planes, and Israel and Mexico, 6 each. Largest territorial consumer in units is Alaska, which purchased 4 planes valued at $29,000, but a single business plane to Puerto Rico was valued at $27.000.

Companies reporting exports included Aero Design and Engineering Co., Beech Aircraft Corp., Cessna Aircraft Co., Piper Aircraft Corp., and Taylorcraft, Inc.

Bendix Polar Path Used For Fairchild Jungle Oil Survey

A Beech AT-11 equipped with polar navigational equipment will be used by Fairchild Aerial Survey in a search for oil deposits in the jungles of southern Peru. The area has never before been surveyed for oil from the air, and because perfect straight line navigation will be required to obtain an accurate "magnetic profile" of the earth below the jungle, the plane will be equipped with Polar Path, a highly accurate gyro navigational system developed by Ben-

dix Aviation Corp. for commercial flying over Arctic regions where magnetic compasses are unreliable.

The plane, under the command of Pilot John Bratton, will cover about 10,000 linear miles over the jungle, at a constant altitude of 1500 feet. A magneto-meter will dangle by a cable 100 feet below the plane, and will automatically detect changes in the earth's subsurface magnetic make-up, and record them on a continuous chart. Interpretation of these charts provides oil geologists with clues as to the depth of subsurface rock and the location of possible oil structures.

The Bendix Eclipse-Pioneer Polar Path, installed at Fairchild's operational base at Lockheed Terminal, Burbank, by Pacific Airmotive Corp., is an extremely precise directional gyro unit about the size of a baseball. Spinning at 22,000 rpm, the gyro characteristically resists any effort to change its position, and keeps the plane directly on its course through automatic controls with an error factor of less than one degree per hour.

First Smith CW20-T to Canada

The L. B. Smith Aircraft Corp. has made its first Canadian delivery of the CW20-T transport. The new plane, going into service with World Wide Airways, Montreal, is the fourth in this series, exclusive with L. B. Smith, of remanufactured C-46's. The first was delivered to Eastern Air Lines, and two more were subsequently delivered to an airline operating in South America.

The CW20-T is authorized a gross takeoff weight of 47,650 pounds for passenger and cargo carrying, and features R-2800-C engines rated at 2100 hp. Safety refinements of the CW20-T include a secondary firewall separating the power and accessory sections of the engine, improved fire detecting and extinguishing system and engine power-loss detection devices, and escape doors opening from both inside and outside the plane.

L. B. Smith has set up a production line for the manufacture of CW20-T conversion kits, the only one currently available to give the C-46 Transport Category Certification.

Narco Distributes Marconi ADF

The National Aeronautical Corp. and the Marconi Co. of Montreal have signed an agreement whereby Narco will handle U.S. distribution of the Canadian Marconi 301 automatic direction finder, and Marconi will handle Canadian distribution of the Narco standard line equipment for business aircraft and the Sapphire navigation and communications line, which is type-certificated by CAA for airline use.

The Marconi ADF will be added to Narco's Sapphire line, which also includes DME and VHF equipment. The new Canadian unit is uniquely sensitive, and features light weight and suppressed loops to reduce drag. It will be distributed nationally by Narco.

Copter Facilitates Cuban Expansion

THIS BELL 47H *helicopter was recently purchased by the Republic of Cuba to enable Public Works Minister Nicholas Arroyo personally to coordinate and supervise the 350 million peso building program under way throughout Cuba's 44,000 square miles. With the helicopter, Arroyo has full and easy access to Cuba's new highways, hospitals, schools, port improvement operations and other construction projects now in progress.*

FIRST AERO COMMANDER *to be delivered in Europe recently completed its Atlantic crossing. The five-place twin was purchased by Buchdruckerei Carl Meyer, a bookbinding and publishing firm of Zurich, and will be used for business trips throughout Europe. The plane was flown from Aero Design & Engineering Co., Bethany, Okla., to Zurich by Capt. Horst Meyner, left, of Swissair, and Armin Meyer, right, of the publishing firm. Sale of the Commander was made through Hary von Rautenkranz of Celle, Hanover, Germany, Commander distributor for Switzerland, West Germany and Luxembourg.*

Plastic-Coated Panels Have Decorative, Structural Qualities

A new product suitable for executive conversion interiors, combining the structural strength of steel with the decorative effects of vinyl plastic, is now in experimental production at U.S. Steel's Irvin Works, Dravosburg, Pa.

The material is produced by coating cold-reduced steel sheets with liquid plastic which is subsequently embossed with the desired design or texture.

The plastic coating has effective sound-insulation qualities, as well as resistance to electricity, abrasion, humidity and many chemicals.

The new product will be supplied in any standard color. The pilot facilities at the Irvin Works will produce 18- to 28-gage sheets 24 to 52 inches wide.

Seven Companies Give Statistics on Business Plane Shipments for July

Shipment, during July, of 465 one- to ten-place general utility and executive aircraft by seven U.S. personal plane manufacturers was announced by Aircraft Industries Association of America.

Included in the shipments were 423 planes of four-place or larger, and 42 one- and two-place aircraft, with a total dollar value of $8,049,000. Shipments by the same manufacturers in June totaled 589 aircraft valued at $9,093,000.

Industrial aviation has increased tremendously since World War II, and

(Continued on page 26)

administration

"Administration" of one of a fleet of business aircraft is a big job. This department will report on the problems of the operator, such as:

Rules and regulations

Selection of pilots, co-pilots, and mechanics

Maintenance of flight personnel qualifications

Accounting methods and procedures

Forms used for flight and ground records

Dispatch and utilization

All readers will benefit greatly from a free exchange of administration methods. Address your ideas to Administration Coordinator, SKYWAYS for Business, 122 East 42nd Street, New York 17.

CAA Realigns Functions Under New Program Office System, Announces Changes in Personnel

To streamline its operations, the Civil Aeronautics Administration has realigned CAA functions under six major program offices, and announced a number of changes in personnel assignments.

The six offices are:

The Office of Air Traffic Control, responsible for the safe and orderly separation of aircraft in flight;

The Office of Air Navigation Facilities, responsible for the design, construction, maintenance and inspection of navigation, traffic control and communications equipment;

The Office of Flight Operations and Airworthiness, responsible for examination, certification and inspection of aircraft operations, maintenance, design and manufacture, and the related facilities and personnel;

The Office of Airports, responsible for the establishment of adequate airport facilities for civil aviation;

The Office of International Cooperation, responsible for CAA's relations with foreign governments and international aviation organizations;

The Technical Development Center in Indianapolis, responsible for CAA's technical research and development activities.

The division of the former Office of Federal Airways into Air Navigation Facilities and Air Traffic Control had previously been announced, along with the acting heads. Now confirmed as Director, Office of Air Navigation Facilities, is Joseph H. Tippets, with Peter Caporale as his deputy, and David S. Thomas as Director, Office of Air Traffic Control, with Henry S. Chandler as his deputy.

The former Office of Aviation Safety becomes the Office of Flight Operations and Airworthiness, with the same Director, W. B. Davis, and Omer Welling remaining as deputy. All functions of the former International Region having to do with safety in international air carrier operations will be transferred to this office.

Other activities of the International Region, including the U.S. participation in technical assistance programs and cooperation with other international organizations, including the International Civil Aviation Organization, will be carried on in the new Office of International Cooperation. No head for that office had been named.

Responsibility for public information will be exercised by the Administrator's office with a Press and Publications Officer reporting to the Deputy Administrator. The flight information and library functions of the present Office of Aviation Information will be transferred to the General Services Office.

Counterpart organization of the six CAA Regional Offices will be established wherever there is a clear cut program that requires field execution.

Charles J. Lowen, CAA Administrator, characterizes the six new units as "basic organization units that will be able to devote themselves to specific missions, all of which add up to greater safety in civil aviation," and to "provide the direct lines of communication needed in large organizations such as ours."

Other personnel reassignments:

J. M. Beardslee, formerly Assistant Administrator for Operations, is replacing Edgar N. Smith as Administrator of the Sixth Region (Hawaii and Pacific Area) and Mr. Smith will come to Washington to be in charge of the Second Washington Airport Project. Joseph D. Blatt, formerly Assistant Administrator for Planning, Research and Development, will become Deputy Regional Administrator of Region I in New York, succeeding E. S. Hensley, who will become Deputy Regional Administrator in Region 4 at Los Angeles. The jobs formerly held by Beardslee and Blatt have been abolished.

Ben Stern, formerly Director, Office of Aviation Information, has been made Staff Assistant, and assigned to a special project on Aviation Education directly under the Administrator. Raymond Nathan, formerly Deputy, becomes Acting Director.

Mr. Lowen pointed out that the realignment of personnel will result in the placement of experienced men in positions where their experience is most valuable, so as to provide "a direct line of command as the basic core of CAA organization."

"Scenario" Instrument Rating Exam Stresses Realistic Flight Planning

Officials of CAA have introduced a "scenario" type of written examination for instrument pilot rating in which the pilot goes through all the planning and paper work he would carry out for a real flight between two points, working from actual charts, weather maps, Airman's Guide, and similar reference material.

The new objective type examination is made up of 80 questions with four alternative answers to each question, and is designed for rapid electronic machine grading. The questions are based on flight from Kansas City to Denver and from Denver to Albuquerque. The route was test-flown by CAA Aviation Safety personnel in a typical business plane to make the examination as practical and realistic as possible.

A preliminary study guide, and subsequently a complete study guide containing a sample examination, will be made available through the CAA Office of Aviation Information. The examination is given at Aviation Safety District Offices throughout the country.

AOPA Statement on VORTAC

The AOPA has characterized the recently adopted VORTAC radio navigation system as "a dark chapter in the history of civil aviation."

In its statement on the issue, the AOPA points out that the VOR/DME system was one agreed on, in 1947, by highly qualified members of U.S. aviation, and that the Common System, winner of the Collier Award as the greatest aviation achievement of the year, was heavily financed by Congress.

According to the AOPA statement, the nub of the problem lies in the inconsistency of the military, which at first agreed that the Common System should have to serve for non-tactical military flying. The military subsequently "forced those rules to be changed to say that whatever system was used, the Common System now had to serve tactical flying as well." AOPA goes on to observe that the issue was further forced by large military investment in TACAN.

AOPA's objection to the VORTAC decision is based not only on these economic considerations, but also on the precedent that may have been established in this concession to the needs of the armed forces, which, "under the Constitution, are supposed to serve the American people," and which, instead, "have . . . defeated civil aviation in this country."

Program for the N.B.A.A. 9th Annual Forum Miami, October 23, 24, 25

Tuesday, October 23

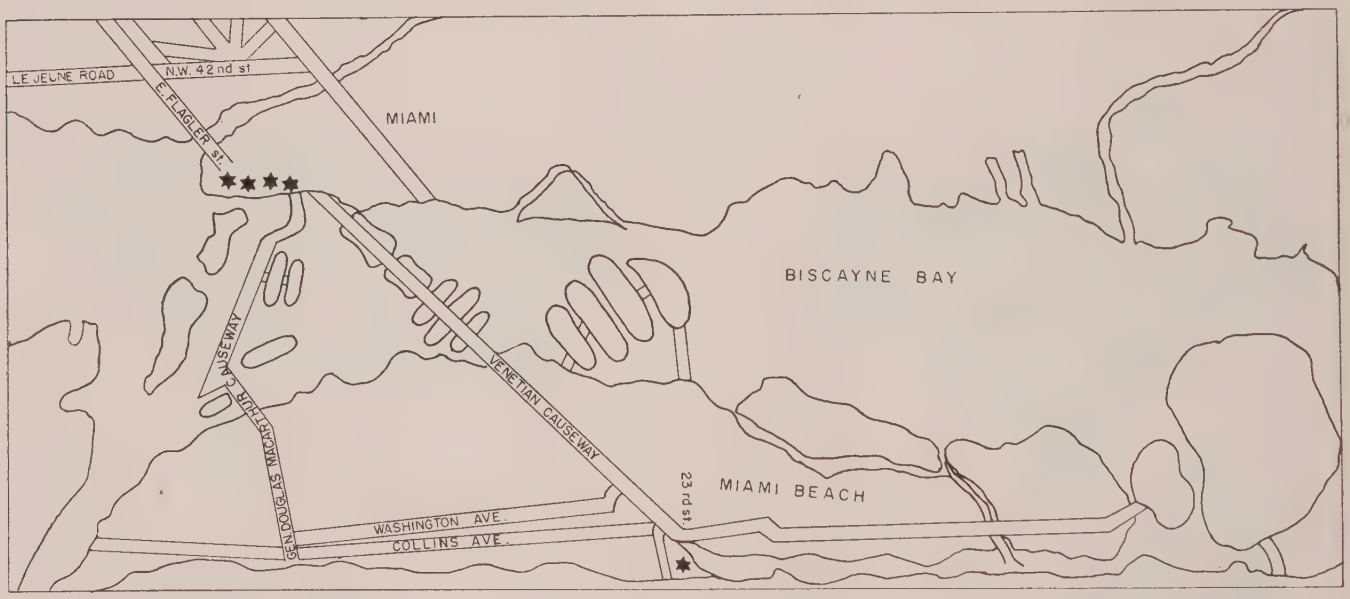
8:30 AM to 7:30 PM	McAllister Hotel, Sun Room, *Registration*
2:00 PM to 5:00 PM	McAllister Hotel, Flagler Room, *Annual Membership Meeting.*
6:30 PM to 7:30 PM	McAllister Mezzanine, *"First Niter" Hospitality Hour.*

Wednesday, October 24

8:30 AM to 7:30 PM	McAllister Hotel, Sun Room, *Registration*
9:00 AM to 10:00 AM	McAllister Hotel, Biscayne Room, *DC-3 Panel.* Columbus Hotel, Santa Maria Room, *PV-1, Super Ventura, B-23, Convair Panel* McAllister Hotel, Flagler Room, *Light Twin Panel*
10:45 AM to 12:15 PM	Columbus Hotel, Santa Maria Room, *Lodestar-Learstar Panel* McAllister Hotel, Biscayne Room, *Twin Beech Panel*
12:30 PM to 1:45 PM	Bayfront Auditorium, *"Get Acquainted" Luncheon*
2:00 PM to 3:15 PM	McAllister Hotel, Flagler Room, *"Airways Traffic Control"* meeting
3:35 PM to 5:00 PM	McAllister Hotel, Flagler Room, *Radio and Communications Panel*
5:10 PM to 11:00 PM	Roney-Plaza Miami Beach Hotel Gardens, *"Florida Fun Night"*

Thursday, October 25

8:30 AM to 7:30 PM	McAllister Hotel, Sun Room, *Registration*
9:00 AM to 10:30 AM	McAllister Hotel, Flagler Room, *Pratt and Whitney Engine Forum* Columbus Hotel, Pan American Room, *Lycoming Engine Forum*
10:30 AM to 10:45 AM	Coffee Break
10:45 AM to 12:00	McAllister Hotel, Flagler Room, *Wright Engine Forum* Columbus Hotel, Pan American Room, *Continental Engine Forum*
12:15 PM to 1:30 PM	Bayfront Auditorium, *NBAA Annual Awards Luncheon*
1:45 PM to 3:00 PM	McAllister Hotel, Flagler Room, *Radar Forum*
3:00 PM to 3:15 PM	Coffee Break
3:15 PM to 5:00 PM	McAllister Hotel, Flagler Room, *"Looking Ahead"* meeting: Airframe, Engines, Radio, Airways, Airports, Radar, ATC
6:30 PM to 7:45 PM	Bayfront Auditorium, *NBAA Annual Hospitality Hour*
7:50 PM	Bayfront Auditorium, doors open to banquet hall
8:00 PM to 10:15 PM	Bayfront Auditorium, *NBAA Annual Banquet and Honors Night*



A SIMPLIFIED DRAWING OF MIAMI *to help you find your way among the functions of NBAA's 9th Annual Forum. Miami International Airport is at top left, near N. W. 42nd Street. The four stars represent (l to r) the Hotel McAllister, Hotel Columbus, the Biscayne Terrace Hotel, and the Bayfront Auditorium. The hotels are on the north side of Biscayne Boulevard; the auditorium is on the south side, in Bayfront Park. Busses will operate between the hotels and the auditorium, and between Miami and Miami Beach.*

◀ **THE RONEY PLAZA HOTEL,** *Miami Beach (indicated by the star at the bottom of the map), where Florida Fun Night will be held on Wednesday, October 24th. Its location and facilities make it ideal for your own vacation in Miami Beach this winter.*

The NBAA 9th Annual Forum will include many activities which occur simultaneously. To help you get the most from your visit, we highlight some of these activities here:

- Wednesday, Oct. 24, 9 AM to 10:00 AM: DC-3 Panel, Santa Maria Room of the Columbus; PV-1, Super Ventura, B-23, Convair Panel, Flagler Room of the McAllister.
- Wednesday, Oct. 24, 10:45 AM to 12:15 PM: Lodestar-Learstar Panel, Santa Maria Room of the Columbus; Twin Beech Panel, Biscayne Room of the McAllister.
- Thursday, Oct. 25, 9 AM to 10:30 AM: Pratt & Whitney Forum, Flagler Room of the McAllister; Lycoming Forum, Pan American Room of the Columbus.
- Thursday, Oct. 25, 10:45 AM to 12:00 noon: Wright Engine Forum, Flagler Room of the McAllister; Continental Engine Forum, Pan American Room of the Columbus.

navicom

Devoted to information regarding the operation of business aircraft from first scheduling through flight completion, and the factors bearing on those operations, such as facilities, equipment, problems of navigation and communications, airspace regulations, new ATC procedures and new flying techniques. Comments and suggestions are invited.

New CAA Nav-Aid and ATC Services Program

A program of navigation and traffic control facilities to be installed by the CAA during the fiscal year ending June 30, 1957, has been announced by Administrator Charles J. Lowen.

The program features establishment of long range radar at 26 locations. The New York air route traffic control center, which already has a long range radar in operation, will get additional information piped into the New York center from a long range Navy radar at Atlantic City, N. J., already employed in a radar-airway experiment this past year on the busy NY-DCA routes!

Besides New York, the Washington air route traffic control center has a long range radar in operation and it is estimated that long range radar will be commissioned at Norfolk about September 1 and at Chicago by November 30.

The locations scheduled for long range radar in the fiscal year 1957 program are as follows:

Albuquerque, N. M.
Atlanta, Ga.
Boston, Mass.
Buffalo, N. Y.
Cleveland, Ohio
Denver, Colo.
Detroit, Mich.
El Paso, Texas
Ft. Worth, Texas
Houston, Texas
Indianapolis, Ind.
Jacksonville, Fla.
Kansas City, Mo.
Los Angeles, Cal.
Memphis, Tenn.
Miami, Fla.
New Orleans, La.
Oakland, Cal.
Phoenix, Ariz.
Pittsburgh, Pa.
St. Louis, Mo.
Salt Lake City, Utah
San Antonio, Texas
Seattle, Wash.
Spokane, Wash.

The fiscal 1957 program also includes 17 locations where CAA will establish airport traffic control; 19 to get high-intensity approach lighting; two that will receive airport surveillance radar; 82 very high frequency omnidirectional radio ranges (VOR), and 34 airports where additional frequencies for air-ground communication in traffic control will be provided. One new air route traffic control center will be established at Phoenix, Arizona.

Airports to get airport traffic control towers are:

Columbus, Ga.
Erie, Pa.
Fargo, N. D.
Fayetteville, N. C.
Hobbs, N. M.
Lafayette, La.
Longview, Texas
Lynchburg, Va.
Macon, Ga.
Rockford, Ill.
Salem, Oregon
Santa Fe, N. M.
St. Joseph, Mo.
Stockton, Cal.
Utica, N. Y.
Westfield, Mass.
Worcester, Mass.

High-intensity approach lights will be installed at:

Albany, N. Y.
Atlanta, Ga.
Austin, Texas
Billings, Mont.
Birmingham, Ala.
Burbank, Cal.
Charleston, W. Va.
Columbus, Ohio
Dallas, Texas
Dayton, Ohio
Ft. Wayne, Ind.
Greensboro, N. C.
Houston, Texas
Indianapolis, Ind.
Louisville, Ky.
Nashville, Tenn.
Newark, N. J.
Spokane, Wash.
St. Louis, Mo.

Airport surveillance radar will go in at Miami, Fla., and Colorado Springs, Colorado.

The VOR program for fiscal 1957 is as follows:

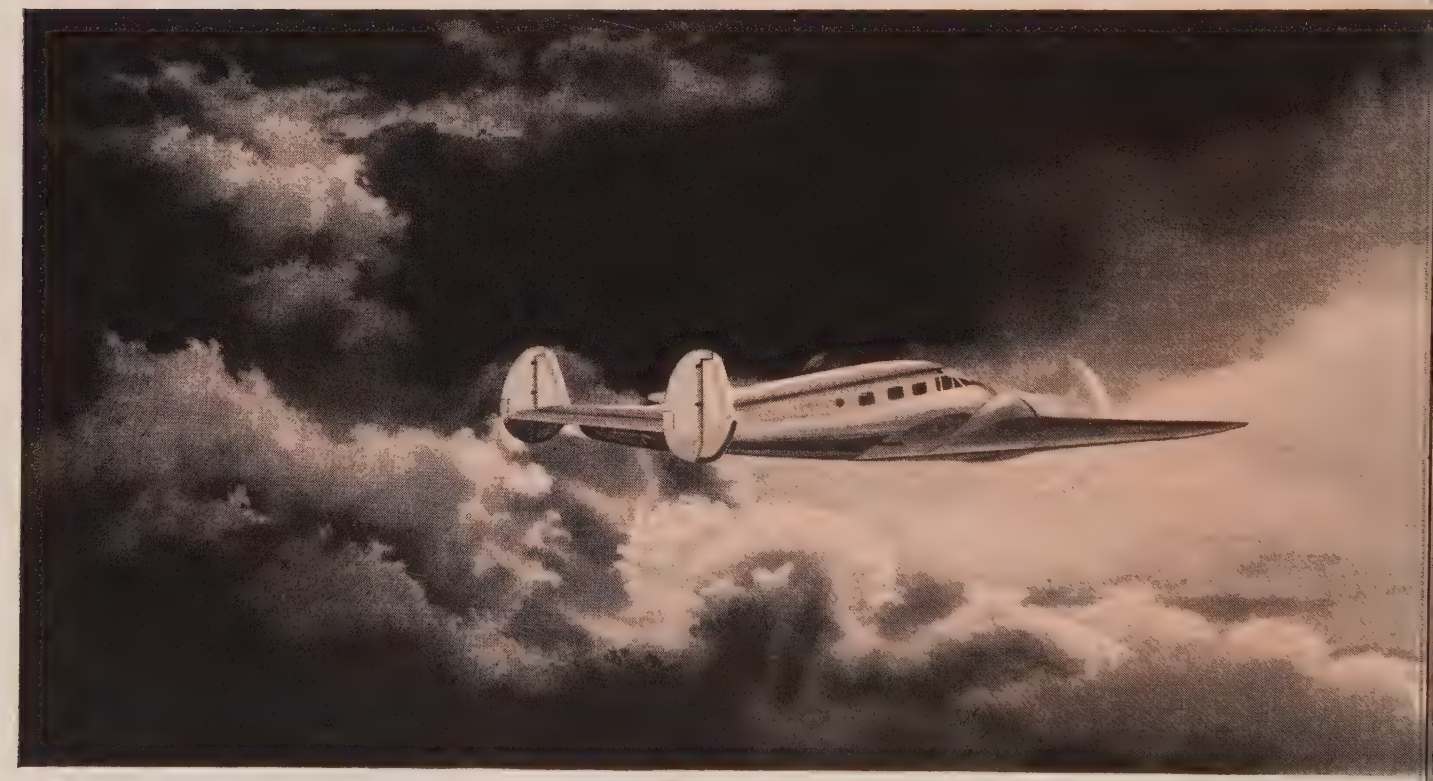
Agricola, Ga.
Akron, Ohio
Altoona, Pa.
Astoria, Ore.
Austin, Nev.
Basolt, Nev.
Beatrice, Neb.
Bishopville, Md.
Blackwells Corner, Cal.
Burlington, Vt.
Canton, Ohio
Carrollton, Mo.
Cayutaville, N. Y.
Charlestown, W. Va.
Cincinnati, Ohio
Clarksburg, W. Va.
Cody, Wyoming
Coles Point, Va.
Coxcomb, Cal.
Crandall, Texas
Decatur, Ill.
Del Rio, Texas
Detroit City, Mich.
Edenville, N. Y.
El Centro, Cal.
El Creek, Wash.
Elgin, Wash.
Ethel, Wash.
Evanston, Ill.
Farallon Islands, Cal.
Fern Prairie, Wash.
Flint, Mich.
Fowlerville, N. Y.
Gilroy, Cal.
Gulfport, Miss.
Hickory Grove, Pa.
Hog Island, Va.
Huntington, W. Va.
Hyannis, Mass.
Jamestown, N. Y.
Jefferson, Mo.
Keene, N. H.
Knobnoster, Mo.
Lakeview, Ore.
Lancaster, Pa.
Liberty, N. Y.
Manchester, N. H.
McCall, Idaho
McCracken, Pa.
Milford, Del.
Miami, Fla.
Molokai, T.H.
Mooresville, Mo.
Newcomerstown, Ohio
Newhall, Cal.
New Madison, Ohio
Northfield, Vt.
O'Neill, Neb.
Oshkosh, Wisconsin
Princeton/Bluefield, W. Va.
Polvardero, N. M.
Rainelle, W. Va.
Richland Center, Ind.
Richmond, Ind.
Rock Springs, Ariz.
San Bernardino, Cal.
Sandusky, Ohio
Shelbyville, Ind.
Shipman, Ill.
Show Low, Ariz.
Sidney, N. Y.
Sparta Junction, N. J.
Sweetvalley, Pa.
Springville, Pa.
Vesta, Va.
Walhalla, S. C.
Warm Springs, Nev.
Waterville, N. C.
Wellsville, N. Y.
Westfield, Mass.
Williamsport, Pa.
Zanesville, Ohio

Equipment for automatic weather broadcasting will be installed at the following locations:

LONG RANGE RADAR *will be installed during 1957 at the locations indicated by "R."*

RCA announces a avoidance

for installation in aircraft where weight, space, and power are at a premium.



RCA®

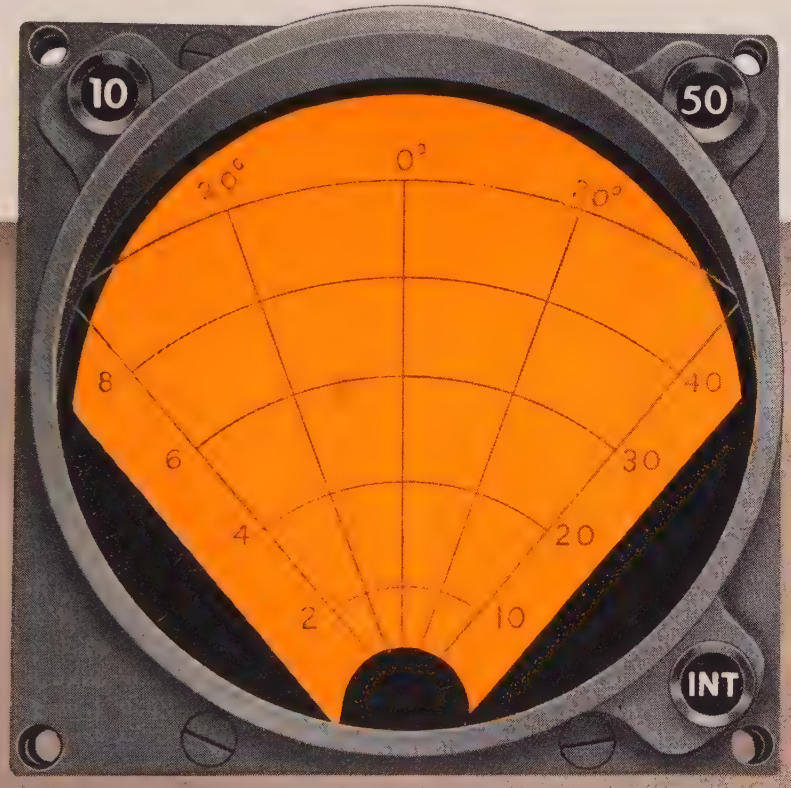
Address Inquiries to

CUSTOM AVIATION EQUIPMENT

RADIO CORPORATION of AMERICA

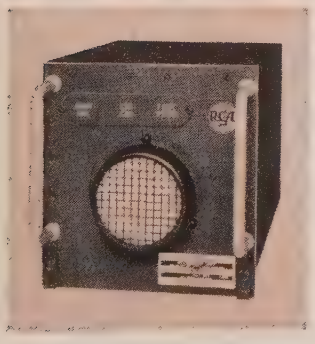
11819 W. OLYMPIC BLVD., LOS ANGELES, CALIF.

new weather radar, the AVQ-50

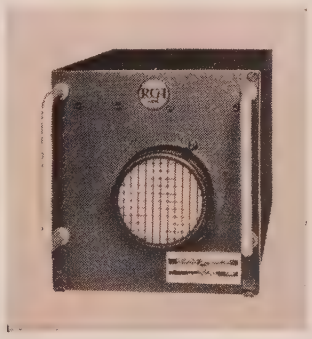


Indicator—actual size for Standard Instrument-Panel Mounting

Accessory Unit



Receiver-Transmitter



Antenna

Typical Antenna Installation in Beech D-18

Billings, Mont.
Birmingham, Ala.
Boise, Idaho
Denver, Colo.
Detroit, Mich.
Garden City, Kan.
Grand Marais, Mich.
Indianapolis, Ind.
Knoxville, Tenn.
Miles City, Mont.
Millinocket, Me.
Milwaukee, Wis.
Missoula, Mont.
Omaha, Neb.
Rapid City, S.D.
Wichita, Kansas

The new air route traffic control center at Phoenix, Arizona will cover parts of the territories now handled by the Albuquerque, El Paso and Los Angeles Centers.

Transistor Magnetic Power Supply Seen

A transistor magnetic power supply that fits in the palm of your hand has been announced by Hycon Mfg. Co., Pasadena, Calif. Designed to replace small vibrators, inverters or dynamotors, it is only 2" x 2½" x 3" and weighs just 1½ lbs.

Produced in limited quantities, the Hycon-Verter has a 24-volt DC input and provides outputs of 115 volts, 400 cycle AC, and 150 volt DC with a 25-watt load rating.

The instrument, which has no moving parts, supplies AC power for gyroscopes, servo-motors and magnetic amplifiers; and high voltage DC for mobile use such as walkie-talkie units, vehicular, aircraft and marine communications, and allied electronic equipment. It also is useful as an AC power source to synchros, microsyns, etc. It has efficiencies of as much as 90%, contrasted with 50-60% of vibrator-type power supplies.

It features an almost total absence of radio and acoustic noises.

Miniature Lightweight Radar Beacon

With the accelerated importance of radar in the new ATC picture, the need for an interim practical radar beacon pending more extensive development is a must. A new miniature, lightweight radar beacon designed to enable ground crews to track a guided missile in flight, developed by Radio Receptor Co., Inc., of Brooklyn, N. Y., holds promise of meeting this need.

Though it weighs only 2½ pounds and is roughly the size of a jelly jar, the new device, called the Radar Beacon, AN/DPN-43 is rugged enough to withstand the terrific shocks and temperature variations of missile flight.

The new beacon's job is to receive and return radio signals monitored at a ground tracking point. Its whole service life is only 30 minutes or so, but it is designed for utmost reliability. Weight, space and reliability considerations required the use of transistors instead of tubes. More than 120 components have been squeezed into its 6-inch height and 2½-inch diameter.

The beacon, which was developed for the Evans Signal Laboratory of the Army's Signal Corps Engineering Laboratories at Fort Monmouth, N. J., consists of three main assemblies: a tiny 6-volt battery, a tuned preselector with a high-gain crystal-video receiver, and a modulator driving a low-power trans-

Air-Aids Spotlight

AKRON - CLEVELAND - MANSFIELD, Ohio—*NAS Akron acrobatic area between these points still not official restricted area despite hazard.*

AUSTIN, Texas—*VOR and ILS Middle Marker shut-down.*

BRADFORD, Ill. — *VOR/DME shut down.*

BRIDGEPORT, Conn. — *Southwest LFRange approach approved straight-in initial only, 1000' from BAY to STANNE int. (ILT 135°R), 600'-1 mi. minimums.*

BURBANK, Cal.—*Glendale ADF beacon now "GCE"*

COLUMBUS, O.—*New BVOR site near APPLETON, 058° 19 s. mi. from airport.*

DETROIT, Mich.—*WAYNE MAJOR ILS shut down.*

DICKINSON, N.D. — *VOR shut down.*

FRESNO, Calif.—*ILS shut down.*

JOPLIN, Mo. — *ILS minimums now to 300'-¾ mi.*

MASON CITY, Iowa—*VOR shut down.*

MONTREAL, Que. — *Circling minimums only using ILS serving Runway 10 due construction.*

MORGANTOWN, W.Va.—*Use of DME lowers VOR minimums to 600'-1 mi.*

NORFOLK, Va.—*Terminal Area Surveillance Radar commissioned on all Center frequencies.*

NORWOOD, Mass. — *ADF Beacon due for airport.*

PHILADELPHIA, Pa.—*ILS frequency now 109.3 mc, Glide Slope 322.0 cc relocated.*

POMPANO BEACH, Fla.—*Unicom and lights operating, TVOR due this winter.*

PONTIAC, Ill.—*VOR shut down temporarily.*

POTTSTOWN, Pa.—*BVOR on test basis 5 mi. SE of town, on 110.8 mc "PTW", operated by PHILA RADIO.*

ROCHESTER, N.Y. — *ILS frequency changed to 109.5 mc, Glide Slope 332.6 cc.*

SEATTLE, Wash. — Combined *LFR/ILS Back Course approach approved to 400'-1 mi. at SEATTLE-TACOMA.*

ST. LOUIS, Mo. — BVOR shut down temporarily.

TETERBORO, N.J.—*ILS Middle Compass Locator on 326 kc (Tower LFVoice) "EB" commissioned.*

THE DALLES, Ore.—*BVOR frequency now 117.2 mc.*

WATERLOO, Iowa—*TVOR lowest straight-in minimums raised to 600'-1 mi.; twin-engine circling visibility now 1 mile*

WELLS, Nev.—*VOR shut down.*

WHITE PLAINS, N.Y.—*WESTCHESTER CO. ILS now 109.7 mc; Glide Slope 332.2 mc.*

WICHITA, Kan.—*Straight-in ILS minimums now 200-½. LFRange approach to Beech cancelled.*

SPECIAL NOTES — *Automatic weather broadcasts on JOLIET and Los Angeles Ranges suggests means of relieving communications jamming on high density area Center and Approach Control frequencies.—Need for alternate Unicom frequency for larger business aircraft service seen in multi-airport hi-density terminal areas.*

mitter-tuned cavity that can emit a watt or more of output power.

If developed for civil use, a means of manual triggering when desired would justify its availability for emergency use not unlike parachute flares, or with extended life batteries as an ATC aid upon request only.

CAA Issues Caution on Radio Test Equipment

In testing aircraft radio receivers, it is desirable to get a qualitative test of the system, including the antenna and transmission line. Therefore, certain test sets are equipped with an external antenna.

By using the test set with an external antenna, performance of receiving systems in nearby aircraft can be checked; however, the signal radiated from the test set may be of sufficient magnitude to cause interference or produce erroneous navigational information in other aircraft during flight when they are in the general area of the test set. The distance over which a test set signal can cause interference is, among other things, a function of power, frequency, location, antenna characteristics and in the case of VHF frequencies, the altitude of the aircraft involved.

Unconfirmed reports have been received that some test set owners may have added auxiliary amplifiers between the test set and the antenna to increase the radiated power. Such action is almost certain to produce a radiated signal of sufficient strength to require *licensing* by the Federal Communications Commission.

It is recommended that any agency that uses or proposes to use a radiated test signal ascertain that radiation is limited to that which will provide a satisfactory ground test signal and will not cause reception in aircraft during flight. Further information or technical assistance can be obtained from electronics agents of the Civil Aeronautics Administration. Your nearest CAA office can furnish the location of the appropriate office.

New Three-Axis 8½-Pound Pneumatic Autopilot

A new *three-axis* automatic pilot for business aircraft is scheduled for demonstration this month according to Tactair, Inc., a division of Aircraft Products Co., Bridgeport, Pa. The new autopilot, which has been undergoing development and evaluation for the past three years, is operated pneumatically, and will weigh less than ten pounds. Four prototypes of the revolutionary autopilot, which employs no motors or electronic tubes, have been flying in Beechcraft Bonanzas for the past two years. The first pre-production run of fourteen units will be completed in October, and quantity production units are scheduled for completion in the first quarter of 1957.

Although price schedules were not released, the new entry into the field of three-axis control holds interest as a threat to the supremacy of established designs that are subject to the known vagaries of aircraft electrical systems.

A welcome feature of the Tactair is the "vectoring" ability as compared to simple head-holding of other small autopilots. The desired heading is set into the selector, and the Tactair will turn the aircraft to and steady out on the heading. If it is necessary to overpower the controller momentarily, as to go around a cloud build-up on top, it will return the plane to the original heading. On IFR approach, bracketing is simply a matter of selecting the heading.

Earlier this year, the Tactair autopilot was acquired by Aircraft Products Co. when it purchased Tactair, Inc., located at Wings Field, Ambler, Pa. Because of its pneumatic operation, involving precision valves and related components, the design of the Tactair autopilot lends itself ideally to the engineering and manufacturing facilities of the parent company, which for sixteen years has been engaged in the manufacture of precision hydraulic and pneumatic equipment for major military aircraft manufacturers.

Mr. R. B. "Buck" Springer, well-known aviation consultant, business-flying sales specialist and formerly with CAA, has been named sales manager for the Tactair autopilot line.

ACC Announces Solution to VOR/DME TACAN Controversy

In a decision which can only reflect credit on ACC and the industry groups (including our NBAA) which held out for just such an equitable solution, the Air Coordinating Committee has announced a moderate and far-sighted solution to the VOR/DME TACAN Problem.

As pointed out by Henry W. Boggess, President of NBAA, all users of the country's airspace now have some assurance that future investments in air navigation equipment are protected. The overwhelming practicality of continuing the much improved and heavily used azimuth feature of VOR into the foreseeable future is heartening to all classes of civil aviation.

Equal approbation will greet a sincere effort to implement the promise to develop the Tacan compatible or VORTAC DME so that it will be economically feasible for all classes of civil aviation users.

The apparently inevitable conclusion of ACC that current civil DME, by itself alone, did not justify development and extension beyond its present stage can only have been arrived at by knowledge of early, practicable implementation of TACAN so superior that further investment in civil DME would be a betrayal of the public trust in both government and private industry.

Although we may have to wait for the ful details of the information on which ACC based this decision, we can outline the conclusions which constitute the proposed course of action, as follows:

1. The Omni Range VOR Azimuth Navigation System is required by all categories of aircraft operators, and will continue to be expanded as planned both at present and in the long-term future.

2. TACAN should be integrated into the Common System to meet military requirements.

3. The military services will continue their implementation of TACAN in order to meet the national defense requirements of the country. These facilities will be integrated operationally into the domestic Federal Airways and the Air Traffic Control System.

4. The Clear-Channel Distance Measuring Equipment will be integrated into the navigation system in order to provide the civil jet transport, military jets, and other civil and military aircraft with distance measuring and improved air traffic control service by July 1, 1959, for high altitude enroute and for terminal operations.

5. Specifications and prototype equipment should be developed for a TACAN compatible ground DME intended for use at certain VOR and ILS sites, either domestic or international, where required.

6. The NAV Panel will review the distance measuring requirements of general aviation and other users, and recommend appropriate additions for Clear-Channel DME ground environment.

7. In order that aircraft operators presently using DME will be able to continue using the service and in order that operational procedures for the use of distance information may be further developed, and technical training advanced, the distance measuring system presently in operation could be continued until 1960 except as frequency or other conflict with VORTAC necessitates phasing it out of service. The Civil Aeronautics Administration will establish a progressive decommissioning plan for civil DME.

8. The Government will investigate the feasibility of replacing with VORTAC DME the airborne civil DME which has been purchased and installed in civil aircraft prior to August 30, 1956.

9. The Government will lend technical assistance in the development of a low cost, airborne clear-channel DME for general aviation and other users.

10. A decision as to possible use of the ultra high frequency azimuth portion of VORTAC for civil purposes will be considered after this element of the system has undergone wide operational use in military operations, as well as civil in-service evaluation.

11. The United States, consistent with past practice, will take the necessary steps through ICAO to fully advise the Member States of its actions, make technical information available to them, and when appropriate, proposed ICAO consideration of a new distance meas-

uring standard specification.

Briefly reviewing the foregoing, points 1 through 3 establish unmistakably not only that VOR will be continued and expanded in accord with CAA's 3-year accelerated program, but that TACAN will be developed and installed parallel to the Victor airway coverage to augment purely military sites. It is not clear whether military funds or the newly-loosened CAA purse strings will foot the bill.

Point 4 emphasizes that TACAN type DME *only* has the unqualified endorsement of ACC and it is expected that a crash program of installation will enable its implementation by equipped users by mid-1959. Points 5 and 6 hold out some hope that an interim DME program, like black-and-white compatible TV, will cushion the shock for other airspace users pending the development of a TACAN DME economically feasible for all civil users of the airspace.

Point 7, in requiem, suggests that *current* users of civil DME cooperate in turning their doomed investment to practical advantage in the public interest by helping to mold the future usage of DME. For doing this, Point 8 reveals, they may be compensated when the time comes for replacement with TACAN DME. At the same time, due notice is served against any initial investment in this equipment from here on in. *Dealer, distributor, operator and manufacturer's inventory are junk or salvage.*

Although no funds are promised, Point 9 says that official encouragement will be offered to private industry to develop a low-cost version.

Lest we forget, Point 10 holds out that azimuth TACAN is still just around the corner, bloody but unbowed, called not TACAN but UHF VORTAC. The 11th point merely indicates that the U S will apprise ICAO of its action, with possibly the naive hope that it will not be unilateral and unlike our domestic aviation industry, ICAO will be too concerned with such matters as the Suez Canal to bother over the early demise of a navigational system which is almost unknown to them anyway.

In all, only time will tell if the amputation was necessary. The patient, general aviation, is known to be a strong and sturdy, growing youngster. (Ed. Note:—Indication of the alacrity with which the ACC decision of August 30th is being implemented is to be found in the August issue of AIR-AIDS SPOTLIGHT noting the installation of TACAN and VOR/DME modification at Phillipsburg, Pa.!)

ADVANCE REGISTRATION

NBAA 9th Annual Forum

Deadline: Monday, Oct. 15

Write NBAA, 344 Penna. Bldg., Wash 4.

communication navigation control

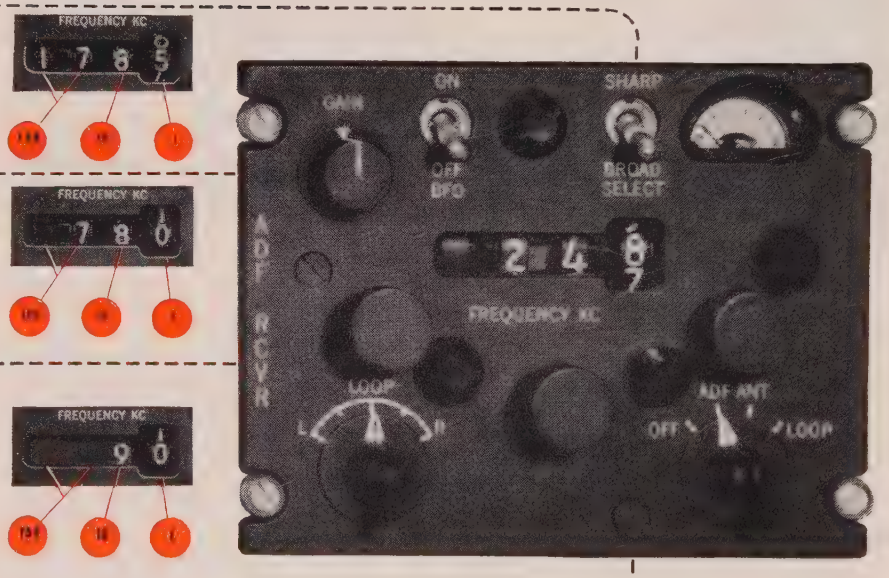
THE NEW ADF

OF COLLINS AIRBORNE ELECTRONICS SYSTEM

RANGE 1000-1800 KC
Rotate 100's knob until first two digits appear in 1000 and 100 kc dials. Next rotate 10's knob for third digit and units knob for fourth digit.

RANGE 100-999 KC
Rotate 100's knob until 1000 kc dial is blank and first digit desired appears on 100 kc dial. Next rotate 10's knob for second digit and units knob for third digit.

RANGE 90-99 KC
Rotate 100's knob counter clockwise to mask 100 kc and 10 kc dials. The latter mask is marked with the "9." Next rotate units knob until frequency appears on units dial. When units dial is rotated above nine, a plus sign appears in window, when rotated below zero, a minus sign.



Receiver Weight: 15.9 pounds
Total Tubes: 11
Receiver Space: ½ ATR
Antenna: Ferrite loop, 6 pounds

Simplified tuning for fast, precision frequency control is one of the improvements of Collins new Automatic Direction Finder system. "Searching for station" is an obsolete operation when using the easy-to-read counter-type dial of the control unit shown approximately actual size. Other distinguishing characteristics are reduction in weight and space, low-power demand and improved reliability.

Write for the new ADF brochure

Collins CREATIVE LEADER IN AVIATION ELECTRONICS

COLLINS RADIO COMPANY, 315 2nd Ave. S.E., Cedar Rapids, Iowa • 1930 Hi-Line Drive, Dallas 2 • 2700 W. Olive Ave., Burbank
261 Madison Ave., New York 16 • 1200 18th St. N.W. Washington, D.C. • 4471 N.W. 36th St., Miami 48 • 1318 4th Ave., Seattle
COLLINS RADIO COMPANY OF CANADA, LTD., 11 Bermondsey Road, Toronto 16, Ontario • COLLINS RADIO COMPANY OF ENGLAND, LTD., 242 London Road, Staines, Middlesex

The Three Patriarchs

(*Continued from page* 12)

pendent upon the vendor for his data, although any good thermodynamics engineer could confirm the vendor's calculations.

To complete the analysis of powerplants, an operator would have to evaluate such items in the powerplant as may affect Drag. The use of cowling redesigns, prop spinners, and modified cowl flaps is well known, and contributes much to improve performance through reduced drag.

Of equal significance are the cooling drag of the engines and windmill drag of an inoperative engine-propeller combination. Of the three engines mentioned above, the -92 and -94 engine-propeller combinations have identical windmill drag, and the -94 engine has slightly less cooling drag. The R2000 engine-prop combination, because of the broader propeller blades and lower reduction-gear ratio of the engine, has substantially greater windmill drag than either the -92 or -94 combinations. The cooling drag is about the same as that of a -92. The greater windmill drag of an inoperative R2000 at V_2 speed in a DC-3 consumes about 39 hp of the operating engine, a 20% loss of available thrust horsepower for first segment single-engine climb on a DC-3 grossing 26,900 pounds.

An operator can obtain this data for his own check list from a consulting engineer; he can obtain engine cooling drag figures from the engine manufacturers, and windmill drag figures from the manufacturer of his aircraft.

One development worth consideration is a new concept of engine cooling baffle design developed by Mr. Ben Howard, consultant to the Fairchild and Convair companies. Mr. Howard's baffles achieve the same cooling characteristics of conventional baffles with less drag.

Mr. Howard first installed these baffles on R2800-CB16 engines during an assignment to increase the cruising speed of Convair 340's. His handling of the difficulty in evaluating each element of his project was truly ideal. At the start of his program, he specified that two 340's be assigned to him. One was to incorporate all the "clean-up" modifications, and the other was left "as is."

His first step was to fly both aircraft in formation before any modifications were performed, to compare their performance under all flight conditions, and to establish the basis for later comparative calibrations. When the modification on one airplane was completed, the two ships were again flown and exact comparisons in performance made. There had been a net gain of 18 mph in cruising speed for the modified airplane, with no increase in power.

Next, each element of the modification package was removed, one by one. After each element was removed, the two aircraft were flown again to calibrate exactly what that particular element had contributed. After the last element was removed, the two aircraft were again flown to compare their performance in the original configuration.

In conclusion, I would like to emphasize that I have not intended to criticize modification programs or modification specialists in general. My intent has been to highlight the circus of today's modification proposals and the problem they present to so many operators.

I feel that there is a great deal of "stretch" still to come in the performance of today's aircraft which will be brought about by improvements in Thrust, Drag and Weight. I predict that in two years, DC-3's will be operating at 26,900 pounds, flying 220 mph at no increase in direct hourly operating costs.

In addition, I predict that in five years, DC-3's will be certificated for 28,000 pounds gross weight, and will surpass today's best performance easily at that weight. In eight years, I believe DC-3's may be licensed for 30,000 pounds gross, and be powered by turboprop engines burning 10% less fuel per hour than today, at speeds of around 250 mph.

I suggest that we can enjoy such improvements sooner and with much less cost to our industry if better methods of auditing such modifications are applied before money is spent. +++

safety exchange

A clearinghouse of practical information on recent developments affecting flight safety. This will include factual accounts and analyses of actual, in-flight occurrences (near misses, unusual in-flight experiences, conflicting traffic clearances, and other incidents of non-routine nature. In addition, CAA, CAB reports and other sources will be briefed.

Ralph Piper, Chief Pilot, Monsanto Chemical Co., St. Louis, is NBAA coordinator of the Safety Exchange. Readers are urged to advise Mr. Piper of all ideas which may contribute to the safety of business aviation. Address him c/o SKYWAYS for Business, 122 East 42nd Street, New York 17.

Readers Air Their Views:

Invisible Plane at VFR/IFR Fix

Mel Lamb, from East Hampton way, comes in often enough to find that a special problem exists in navigation. He says: "I'm particularly concerned about the airlines and some corporate pilots giving position checks VFR and IFR, and not being at the fix specified, disrupting landing sequences and having a pilot look all over for a plane that just is not there." With the advent of surveillance radar in so many of our busy terminals, those days are about over now, and we are all glad.

Better Info on Preferential Routes

Scott Chapman of Lear, Inc., Grand Rapids, Mich., operating a DeHavilland Dove, suggests that "ARTC make a better attempt to disseminate information on preferential routings. This would ease their own burden by reducing the number of amended clearances."

John Doe Wants to Know:

1. "Why do pilots flying pressurized equipment wait until they are right on top of the traffic pattern before descending. This jeopardizes the lower aircraft, and a collision may occur in the traffic pattern when their cockpit blind spots coincide." It is a well-known fact that at many terminals, pilots flying pressurized equipment practice this sort of thing to avoid that summer turbulence as long as possible. It would seem that, in the light of safety, airport managements should set up a minimum traffic pattern entry altitude, the way they have done in prescribing traffic pattern minimum and maximum speeds.

2. "Just what do those people in the centers and approach control agencies think a DC-3 is capable of doing by way of rate of descent? Particularly in the New York and Washington Areas, we have been instructed to proceed to the outer marker and maintain the same altitude, which is usually our en route altitude, seven or eight thousand feet. When we report over the outer marker, our very next clearance is 'Cleared number one to approach.' In pressurized equipment fantastic rates of descent are possible, but are hardly to be recommended in an unpressurized DC-3. The end result is a delay in all traffic while the standard rate of descent is attempted."

I am sure this department would be glad to reserve space to print the answer to this dilemma, which occurs too frequently to be passed off as a rare case.

3. "Ever work with the nice man in the Pittsburgh Center? We did, several months ago, while flying IFR but on top near Bergholtz. Center called and cleared us to climb another two thousand feet, and when we asked for our traffic, we were told that it was a Connie descending over Bergholtz through our altitude, and to be over Bergholtz at approximately the same time we were to be.

"The Center asked us if we could see the Connie, and we could; he asked the Connie if he could see us, and he did. Our clearance was amended to read 'Maintain VFR until past Bergholtz.' Both aircraft executed the clearance in plain sight of each other, and no time was lost by either. When our reports were made over Bergholtz, the man in the center cleared us from the restriction and his frequency, and thanked us for our cooperation. We thanked him for his, and everyone was happy because the man in the Center had a practical solution to a simple problem instead of making it complex."

CAB Lists Clues Leading to Hazardous Air Turbulence

The Bureau of Safety Investigation of CAB has issued a bulletin containing a list of injuries sustained in air carriers caused by turbulence in flight, during the period 1946-1955. The stated purpose of the report, "to show the extent and seriousness of air carrier accidents caused by inflight turbulence, and to emphasize the importance of safety belt usage during conditions of possible or actual turbulence to prevent injury," is of course relevant to any air carrier, but the introductory remarks to the report, concerning meteorological factors of potentially hazardous turbulence, are especially valuable to the businessman-pilot who, more often than the pilot of a commercial air carrier, is exclusively reliant on his own skill and judgment in arriving at his destination.

The following is a quote of these potentially dangerous meteorological factors described in the CAB report:

"Turbulence of sufficient severity to be potentially hazardous to the occupants of an aircraft in flight will, in nearly all cases, be associated with one of the following conditions:

"1. *Cumulus types of buildups which include thunderstorms and tornadoes.* These may occur in warm, moist air masses, in frontal or prefrontal conditions, or as a result of lifting of moist air over high terrain. In such conditions the hazardous turbulence will usually occur in the cloud development, but may occur in close proximity to it.

"2. *Strong wind over mountainous terrain.* Hazardous turbulence, which may or may not be accompanied by cloud formations, may develop in this condition. This type of turbulence can exist to great heights, and during very strong winds it may be hazardous to a height half again as high as the height of the mountains inducing it. The severest turbulence in this situation exists to the lee of a mountain ridge or peak.

"3. *Frontal zones.* Often cumulus clouds are associated with fronts; however, the air masses involved may be so dry that little or no clouds exist but potentially hazardous turbulence still may occur.

"4. *Wind shear zones.* Actually, wind shear is involved in all types of turbulence; however, there are wind shear situations which do not fall into any of the three categories above. Examples are the boundary zone of a jet stream and an overriding wind of differing direction and/or velocity.

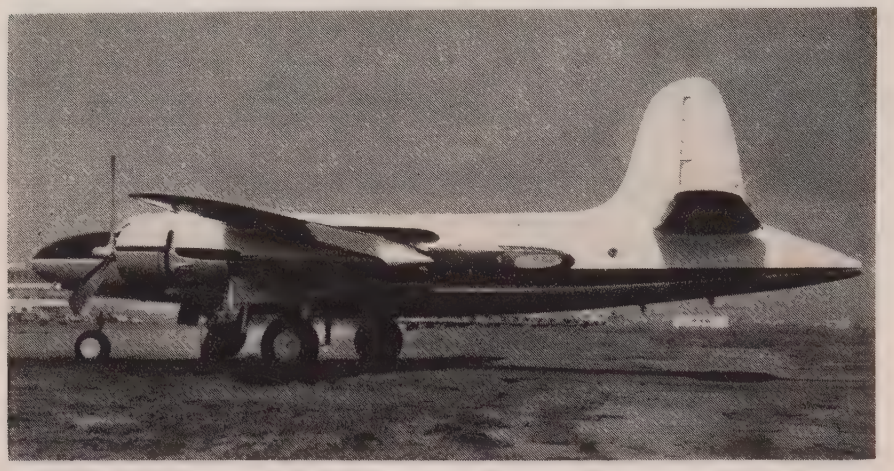
"Normally, there will be no clues visible to the pilot when he is about to enter clear-air turbulence. However, a thorough weather briefing will often disclose such a possibility, making it possible for the pilot to take precautionary measures."

Safety Factor in One-Point Fueling

A design and construction note worth consideration by aircraft manufacturers, the safety factor of a single-point refueling system, is defined in WADC Technical Report #55-505 entitled "Vapor Hazard During Aircraft Refueling."

The report, which is the result of tests taken at fourteen air force bases in the United States, but which has practical application to the refueling operation in any circumstance, shows

(*Continued on page 38*)



EXECUTIVE MARTIN B-26, *an exceptional business conversion of the wartime "Marauder." One of the fastest conversions, it ranks with latest production models in performance.*

(*Continued from page* 23)

now accounts for all but 1500 of the total U.S. civil air fleet of 60,400 planes, and flies three times as many hours as the commercial airlines.

Figures were supplied by the following manufacturers: Aero Design and Engineering Co., Beech Aircraft Corp., Callair, Cessna Aircraft Co., Mooney Aircraft, Inc., Piper Aircraft Corp., and Taylorcraft, Inc.

Edo Six-Month Report: 1956

The Edo Corp., College Point, N.Y., has released the following data on its financial position at the end of the first six months of 1956:

Gross Sales: $3,993,000
New Income before taxes: $645,000
Provision for taxes: $336,000
Net income: $309,000

The 1956 net income represents an increase of $106,000 over the same period in 1955.

First half earnings for 1956 amounted to 57¢ per share, and in reporting to stockholders, President Noel B. McLean announced a current backlog of unfilled orders and contracts totaling $13,723.000.

Cessna 180 Spray Operation Helps Unclog Florida Canals

The Florida Game and Fish Commission uses a Cessna 180 in a tricky low-speed and almost-no-altitude spray operation designed to control the growth of hyacinths which clog Florida canals.

The Cessna, which was brought to Aerodex, Miami for installation of electric spray equipment to replace the old manual system, is flown by Pilot Dean Perra, Aviation Chief for the Hyacinth Control Program, at an altitude of three feet over the surface of the canal, spraying the plants with a hormone which causes them to grow quickly, exhaust all the plant food in the canal, and die an early death.

The Cessna is equipped with two tanks, which hold 45 gallons of spray, and can cover 40 acres of canals in three minutes.

Safety Exchange

(*Continued from page* 35)

that the potential danger of any refueling operation depends entirely upon the number of filling points on any given aircraft. During the vapor hazard survey, which employed explosimeter type instruments, the only place vapors of explosive magnitude were recorded was within two or three feet of the vent outlets. The inevitable conclusion is that by reducing the number of points for the emission of fuel vapors, the potential danger of the operation is removed.

Guggenheim Center Cites Requisites For Achieving Aviation Safety

The introduction of a more adequate air-traffic control system, the need for an electronic proximity-warning device for aircraft, and the increased need for studies in "human engineering" were cited by the Guggenheim Aviation Safety Center at Cornell University as being some of the basic problems in the achievement of air safety.

Air-traffic control was recognized as the foremost aviation safety problem. The Center called for the development of adequate simulation centers where new traffic control plans and devices could be tested in controlled conditions. It is believed that such centers would not only provide comparative data on alternative control systems, but would serve to shorten the time-lag between development and adoption of these techniques.

Also stressed was the necessity for developing electronic warning devices which would instantly alert a plane to any objects in its immediate area.

Observing that there is "no value in building an aircraft or developing a system beyond the capacity of a human to operate," the Aviation Safety Center proposed continued study of such factors as eye functions under stress, the influence of anxiety states in pilot fatigue, noise factors, and simplified instrument presentation.

Greater airport efficiency can be achieved at relatively modest cost, the Center said, by utilizing known developments in lighting, radio and weather services. Existing facilities could thus accommodate not only the anticipated jet-transport program, but would provide facilities for experimental aircraft, such as the VTOL equipment now being developed.

The Center said that better coordination of current activities and increased research were necessary in these areas as well: mid-air collisions, occupant protection, and private flying hazards.

New Training Film on Passenger Escape From Ditched Aircraft

A composite of selected film sequences depicting passenger escape from ditched aircraft has been prepared for use by the aircraft industry for study and training purposes. A 16mm silent film about 1000 feet long, it is intended to serve as a preliminary version of the photographic record prior to completion of the time and motion analyses, publication of a detailed report, and preparation of a training film.

Restricted to industrial and government use, the film can be obtained from Capital Film Laboratories, Washington, D.C. This firm has been authorized to prepare prints upon request from air carriers, airframe manufacturers, and other authorized groups.

A key and comments on the silent film sequences will be forwarded to those ordering copies of the film from the CAA office, Washington.

Watch Intermediate RPM Restrictions

Emphasis should be placed on the fact that there are RPM restrictions on aircraft engines that differ from those marked on the tachometer for maximum continuous use and maximum take-off RPM, but which are as important as the maximums.

These intermediate restrictions are the result of prior determination that aircraft engines develop excessive vibrations at other than maximum speed. Operating at one of these critical speeds, a steel crankshaft may have an operating life as short as twelve hours.

Restricted RPMs are placarded or marked on instruments, but it is possible that a tachometer reading may be inaccurate because of internal wear and head pressure from excessive length of the flexible drive cable. As a result, the engine may operate continuously in a restricted RPM range.

Essentials for Fire Protection

A recent close-call cited by Flight Safety Foundation emphasizes the need for fire warning devices, for an adequate supply of fire-extinguishing chemical, and for a valve to shut off the supply of inflammables to engines.

The aircraft involved was a twin-engine business transport, carrying four passengers and two crew members. The fire-warning signal came on during climb after take-off, and although the pilot pulled the CO_2 and safely returned to the airport, some fire remained in the nacelle after landing. Investigation showed that the main fuel line had not been properly tightened, and had backed off in flight.

Except for the warning device, the pilot was unaware of the fire until the nacelle cowling began to melt, since the smoke trail did not begin until about 100 feet behind the plane.

A single shot of CO_2 was not sufficient to extinguish the fire, which fortunately occurred close enough to an airport to make almost immediate landing possible. Except for this, the fire might have picked up again before a landing could be made.

A logical supplement to the fire extinguishing system in any plane is the device, used on all airlines, to shut off the supply of combustible fluids to the engine compartment.

maintenance

This department covers cost-cutting, time-saving methods and devices for maintaining industrial aircraft efficiency. Technical tips from engine, airframe, electronic, instrument and other components manufacturers, CAA and AD notices, and other sources will be covered. Readers are invited to share their individual mechanical "know-how" with SKYWAYS editors, that it may be disseminated to all operators interested in business flying.

Progressive Maintenance Inspection Authorization Available from CAA

Civil Aeronautics Manual #24 contains all instructions for qualified certificated mechanics who wish to apply for the new Mechanic's Aircraft Inspection Authorization, which grants authority to conduct and approve periodic and progressive inspections and to approve major repairs and alterations.

These additional privileges will be granted to mechanics holding a mechanic's certificate with airframe and powerplant ratings who meet qualifications established as a result of recent revisions to Civil Air Regulations, effective July 17, 1956.

Anyone interested in applying for the authorization should purchase Civil Aeronautics Manual #24, effective July 17, 1956, from the Government Printing Office, Washington 25, D.C.

Mobile Maintenance Scaffold

The Skyworker Corp., Milford, Conn., produces a line of hydraulically operated equipment which replaces ladders and scaffolding. Carrying men aloft on hydraulically operated booms mounted on trucks or trailers, the equipment should be of particular interest to fixed-base operators faced with the problem of inspection, repainting, or maintenance on large aircraft, operations which require scaffolding of some kind, but which are slowed down by the time consumed in fabrication or handling of ordinary scaffolds.

The Skyworker Corp., which is the result of a merger of Tey Mfg. Corp. and the Maxwell Equipment Co., has recently been purchased by the Emhart Mfg. Co., Hartford.

In-Flight Rotor Blade Tracker

A simple lightweight device has been developed by Kaman Aircraft Corp. to permit a helicopter pilot to put his rotors "in-track" during flight.

In order to prevent rough flight and reduced efficiency, helicopter rotor blades must operate in the same plane, and the job is ordinarily a long one performed by a mechanic while the helicopter is on the ground. The new device has enabled pilots who had never used it before to bring rotor blades into track after they had been deliberately misaligned by as much as six inches, while operating the helicopter at speeds up to 60 knots.

The cockpit blade tracker consists of a small crank located in the pilot compartment of the helicopter. The crank, which is turned by the pilot, is connected to an electric step-motor in the rotor hub. The motor is connected to an eccentric in one of the control-system bellcranks. Rotation of the eccentric by the motor causes a change in the pivotal axis of the bellcrank. This in turn results in movement of the output control rod from the bellcrank while the input control rod to the bellcrank remains fixed. This lengthens or shortens the output control rod as the pilot chooses, and causes a change in blade pitch which adjusts the tip-path travel of the rotor blade. The total movement of the blade tracker is not large enough to permit the pilot to create a dangerous amount of misalignment in the rotor blades.

The present device relies upon visual detection of misalignment. Further development is under way which will result in automatic tracking to produce constant in-track condition of the helicopter's rotors.

New Biz Hangar at Teterboro

A new organization, the Teterboro Hangar Corp., formed to provide storage and service facilities exclusively for business aircraft will be complete in June 1957.

In addition to aircraft maintenance personnel, supplementary aircrew personnel will also be available to augment the regular crews of customer aircraft.

Curtiss-Wright Offers New Ultrasonic Maintenance Cleaner

A new ultrasonic cleaner for the maintenance cleaning of aircraft engine parts is offered by the Industrial and Scientific Products Div. of the Curtiss-Wright Corp.

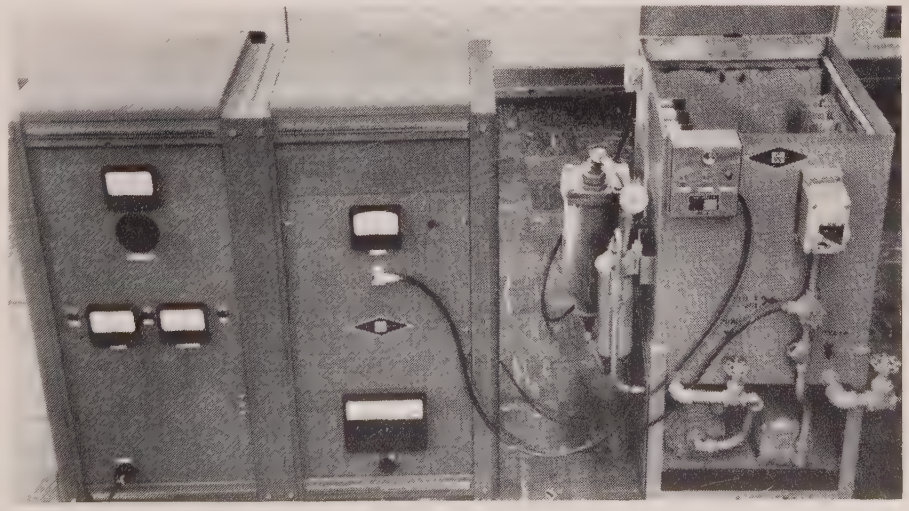
The new cleaner, the CB1-60, is said to offer one of the highest cleaning potentials in the field, and utilizes barium titanate transducers. The unit has a 20 x 24 x 40 inch single stage tank, and provides a working area of concentrated power of one cubic foot.

The unit includes a circulating and solvent-cooling system, drainable and protected sludge sump, explosion-proof motor and switch, automatic off-and-on switch for the ultrasonic generator, solvent filter, valves, and soundhead protectors. It requires 5 kw at 220 v, 60 cycle single phase input. The ultrasonic power output reaches 5 kw peak at 40 kc/sec. The two major units may be operated up to 100 feet apart.

Two- and three-stage units utilizing vapor degreasing and ultrasonic solvent cleaning are available to fit particular circumstances.

Oakland Plans New Engine Plant To Accommodate Expanding Business

Oakland Aircraft Engine Service, Oakland, Cal., has announced plans for a new $250,000 facility for aircraft engine overhaul. Construction will include a 400 x 140 foot steel building.



Ultrasonic maintenance cleaner for engine maintenance cleaning is produced by Scientific Products Div. of Curtiss-Wright. The two units may be operated up to 100 feet apart.

. . . . in the business hangar

■ Spartan Aircraft Co., Tulsa, has installed Goodrich brake assemblies and performed miscellaneous airframe and engine work on the Lockheed Lodestar of Gulf Oil Co. ☐ Spartan removed engines and installed spares on the Lockheed PV-1 brought in by Mr. Everett Dyer, Pilot for Republic Steel, Cleveland. ☐ William Hubbard, Pilot for H. C. Price Co., was in with their Douglas B-23 for 100-hour inspection of airframe, removal of engines and installation of spare engines, plus overhaul of engine accessories. ☐ Parker Drilling Co. was in with their Lockheed 12 for replacement of windshields and sliding windows in cockpit and installation of double cabin windows. ☐ Max Pitcher, Pilot for Aero Service Corp., Mid Continent Div., had their Beech AT-11 in for 100-hour inspection of airframe, engines, instruments and minor repairs. ☐ Lockheed PV-1 from Champion Paper Co. was brought to Spartan for installation of spare right engine, 200,000 Btu Janitrol heater, vibration suppression kit, and minor repairs and modifications to aircraft.

■ Chamberlain Aviation, Akron, has supplied new lightweight Wilcox glide slope receiver, marker and ADF equipment for a complete installation in General Tire and Rubber Co.'s new Aero Commander. ☐ Gardner Board and Carton Co. has its Lockheed Lodestar in for engine change, instrument modification, and installation of dual Lear ADF-14. W. F. Noonan, Gardner CP, is NBAA representative. ☐ Chamberlain has delivered one of their radomes to the Pan Air Corp. for installation on Esso Shipping Co.'s B-23. ☐ Production is also under way on a Douglas B-26 custom radome to be installed by Aircraft Radio and Accessories, Denver. ☐ Work is completed on Procter & Gamble's third DC-3, including installation of Collins W0101 radar, CAIR radome, new generator system, new interior, and annual inspection.

■ Remmert-Werner, St. Louis, has completed radio modernization on the Mannesnann Tube Co. DC-3. Installation included: Collins 17L4-51XVHF 360-channel communications, dual Collins 51R3 omni, with dual indication through RMI, Collins glide slope receiver, Collins 18S4 MHF transceiver, Sperry C4 gyrosyn compass, the new ARC type 21 dual ADF radio compasses, Wilcox radar transponder, 200 amp generators, Leland inverter system, custom radio and instrument panels, Grimes totaling beacon, new cabin interior, and complete exterior repainting. Work was done at R-W's Toledo facility. ☐ The U.S. Industries second DC-3 came to R-W for installation of a Bendix RDR X-band radar, with hinged radome and separately hinged antenna mount. ☐ Mississippi River Fuel Co.'s Twin Beech D18S is at R-W St. Louis for installation of two fresh engines, a new interior, and 1000-hour inspection.

■ Aero Electronics, Inc., Phoenix, has completed conversion of a P-51 Mustang as a high-speed personal business plane. Modification included installation of omni-range navigation, automatic direction finder, marker beacon, range and glide path receivers, and 10- and 50-channel communications.

■ Reading Aviation Service, Reading, has completed the third Super DC-3 modification for United States Steel. Modifications included installation of RCA AVQ-10 C-band radar, autosyn type instruments for fuel and oil pressure, and an auxiliary power unit. Another U.S. Steel DC-3 entered Reading for complete rework of electrical and radio system, including conversion from a 12- to 24-volt system. Also installed: Bendix TA-20/RA-18C Communications, Dual Bendix MN 62 ADF's, Bendix MN53 marker beacon receiver, Bendix MN 100A glide slope receiver, dual Collins omni, Bendix RDR1-c C-band radar, Bendix RTA-1B HF communications, and an ARC 1 50 channel auxiliary transceiver. ☐ Correale Construction Co. brought their new Aero Commander 680 to Reading for radio installation including: ARC 15D omni and CD-1 course director system, Collins 17L-4/51X1A communications, Lear ADF 14, L-2 autopilot with altitude control and approach coupler, Collins 51Z-1 marker and 51V-2 glide slope receiver.

■ Lear Aircraft Engineering Div., Santa Monica, is modifying the Lodestar from Utah Construction Co., San Francisco, to include rudder and elevator spring tabs, empennage reinforcement, retractable tail wheel, new main wheels with single-disc brakes, modernized antenna system, conversion to R-1820-56A engines. ☐ Warren Petroleum's Lodestar, Claire Kingsbury CP, was brought to Lear for Learstar conversion. ☐ Learcal Div. announces Lynch Flying Service, Billings, Mont., as factory distributor for Lear radio, navigation-communication equipment, gyro instruments, autopilots, flight control systems.

■ Welsch Aviation Co., N.Y.C., has received an order for two McKinnon-Hickman 270 hp Lycoming conversion kits for installation on two Super Widgeons operated by Louisiana Wildlife Commission. Installation by Pan Air Corp., New Orleans Airport. Welsch is demonstrating a new 295 hp Lycoming conversion of the Widgeon; conversion features reclining cabin seats, extra cabin window and escape hatch, new modern interior, metal wings and flaps, adjustable seats for pilot and co-pilot.

(*Continued on page* 56)

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"We have found Pacific Airmotive Corporation's 'Advance Planning Service' a highly efficient space, time and dollar saver," states D. V. O' Leary, Director of Purchasing and Stores for United Air Lines. "Because of the benefits derived from this service, United Air Lines has, since 1949, consistently expanded the program, 'til today it encompasses virtually all Bendix Corporation products, plus those of several other manufacturers. By working with us in forecasting future requirements for materials, and by planning their procurement from manufacturers to meet these needs, PAC has enabled us to reduce both inventory and stock-out problems. It has also resulted in shortened lines of communication and a consequent reduction of both communication and transportation costs."

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Round Table

(*Continued from page* 16)

thrust itself would make little contribution in keeping the airplane from making a landing. Further, in the landing run, Jato impinging on the runway would negate its thrust somewhat. In the last analysis, however, it would be the pilot's decision, since it would depend largely on how far from the end of the runway Jato was originally applied. It might well be expended by the time the touch-down is made."

Estelle: "There has been some discussion as to the effectiveness of Jato over all phases of flying. It is my personal opinion that the Jato is most effective for the take-off, especially in the few seconds from V_1 to V_2 speeds, when engine failure could occur."

Putnam: *"Mr. Rice, would you tell us a little more about the basic specification of the 15KS-1000 and the smaller rocket which you mentioned earlier?"*

Rice: "The 15KS-1000 unit has 15 seconds duration at 1000 pounds nominal thrust. It is roughly 10.3 inches in diameter by 33 inches long. It weighs about 144 pounds loaded. The 15NS-250 will be about 6 inches in diameter by 23 inches long. It will produce 250 pounds of thrust for 15 seconds, and is expected to weigh between 40 and 43 pounds, loaded. The 15KS-1000 rockets are certificated for the storage life of two years at propellant temperatures from minus 65° to plus 140° F. Thereafter, they are certificated for standby life, attached to the airplane and ready for instantaneous use, for a period of one year, or 500 hours, whichever occurs first. The rocket requires approximately 24 hours' exposure to a new temperature before the propellant assumes that temperature. The rockets may be used at any altitude up to 35,000 feet. They are tested considerably beyond these limitations in the course of their development. These rocket engines are up to thrust in an average of 2/10ths of a second after actuation of the ignition switch."

Putnam: *"Mr. Dolinski, before we go much further into the details of Jato operation, would you tell us some of your experiences with this rocket? You work for the company that makes them, and undoubtedly some of your experiences and the various techniques you've tried in using them will be helpful to all of us."*

Frank J. Dolinski *(Chief Pilot, Aerojet General Corp.):* "I entered into the DC-3 flight tests of Jato with a neutral attitude. We were delayed in completing the conversion of our airplane, and it wasn't ready until two days before we were scheduled for our first demonstration in Detroit. I told Mr. Rice and others in the company that I wouldn't care to demonstrate to the NBAA in Detroit unless I was satisfied with what I could do with this.

"I hadn't flown DC-3's in several years, so I was very cautious, and my first firing was a single firing, in the air. I found that the power was instantaneous, but smooth, and there were no bad characteristics at all. There was no tendency for any nose up or yaw. At the end of the firing, the loss of thrust is noticeable, but still smooth.

"In simulated engine failure at V_2, which in the DC-3 is 97 mph, with the firing of both bottles, within two seconds the airspeed will go to about 105-110 mph. After 15 seconds we're clean and have a minimum of 400 feet of altitude. These tests were run at about 25,500 gross weight. The significant thing to me was that there's no particular training or practice necessary. Psychologically, you just have two additional engines that are available when you need them. I believe that if I had an actual engine failure, I would fire one bottle, but two feel so good."

Putnam: *"Thank you, Mr. Dolinski. In addition to your experience, and that of Captain Domning, just as important is the experience the company has acquired over the years of making Jato. As I understand, they are not a new device at all, but have been in the development stage for a good many years. Mr. Rice, how long has your company been engaged in this activity?"*

Rice: "The first Jatos were manufactured by the forerunner of Aerojet, which was a group of Cal-Tech scientists headed by Dr. Von Karman, back in 1939. The first unit which was used in actual military work was developed in 1942, and was first put into extensive use, as a means of assisting in the take-off of heavily loaded flying boats, in 1943 and 1944. This was attached to the airplane with the idea of being fired to assist take-off, and for no other reason. It became known affectionately as 'Old Smoky' because of the smoke it produced, and found wide-spread use during and after World War II. Some quarter of a million of these units have been manufactured and used. It was not designed for standby use, and had limitations as to life, operating temperatures and altitudes, but it was used successfully for standby by American, Braniff, Ethiopian and TACA airlines, and the Esso Shipping Company and Holly Carburetor Company in the executive field.

"The 15KS-1000-A1 rocket engine was developed about five years ago for military use, and has just recently been released for civilian use. It is designed specifically for standby use, and in it the objectionable limitations of previous rockets, including the smoke, have been eliminated. There have been some 20,000 of the production configuration of these units fired in service and in tests to date without a single malfunction. Actually, by now, Aerojet has manufactured over 600,000 solid-propellant rocket aircraft engines. This represents more units than there have been civilian aircraft built in the United States since the beginning of the history of aviation. I believe that the number of 15KS-1000 units which have been fired is about as great as the total number of engines that have been utilized in the whole history of scheduled aircraft service in the United States."

Putnam: *"What kind of tests do you use for quality control in the manufacture of these appliances?"*

Rice: "They have been subjected to the most exhaustive type of peripheral tests that we could imagine. In our normal batch testing, they must fire normally after being conditioned at minus 95° or plus 150° F., or cycled to 35,000 feet altitude pressures, or dropped on a concrete mat from heights of three to five feet. They have also been conditioned at temperatures of 175° for a period of four years. This would be equivalent to 64 years of storage under normal temperatures.

"They have also been subjected to bonfires of gasoline-impregnated wood, gasoline fires, and high explosive tests to prove that there is no detonating tendency. They have also been subjected to vibration for over 750 hours, at vibration periods and amplitudes which would destroy an airplane structure, and this has qualified them for 500 hours of standby life."

Putnam: *"Reliability is a problem of interest to everyone who uses these appliances, and perhaps Mr. Swearingen would comment on his opinions on the reliability of these units. Please comment on any pessimism or inherent resistance to accepting these appliances as an adjunct to operations."*

E. J. Swearingen *(Executive Vice President, Howard Aero, Inc.):* "I certainly think reliability is the key factor. From what is known about Jato, the 20,000 successful firings Mr. Rice mentioned speak well for its reliability. The manner in which it is installed in the airplane, the electrical system which supports it, the mechanical installation of the wiring, the switches and the circuit breakers are of equal importance, of course, to the reliability of Jato. We propose to maintain accurate control, to have isolated wiring for Jato installations, and to have an isolated junction box to prevent someone from accidentally firing the Jato while the aircraft is in for maintenance. Also, a circuitry testing instrument has been developed for cockpit installation to permit the pilot to assure himself of the firing circuitry continuity as part of his preflight check."

Putnam: *"That should be a very important factor, because the certainty that the system is going to function would certainly be a fine contribution to the acceptance of Jato. Col. Estelle, do your pilots have any difficulty in orienting themselves, or adjusting themselves, to the use of these units?"*

Estelle: "No, none whatever. Actually, what I have done is to have them fire the bottles once to see what would happen; after that they're sold on the installation. In fact, it is regular procedure with our company now to arm our Jatos before take-off, at the end of the runway. We carry a third crew member on all of our airplanes, and we have him stand by to fire Jato if needed. All we do is call out if we want them, and we've found that this works very nicely. However, it's no problem for either the pilot or the co-

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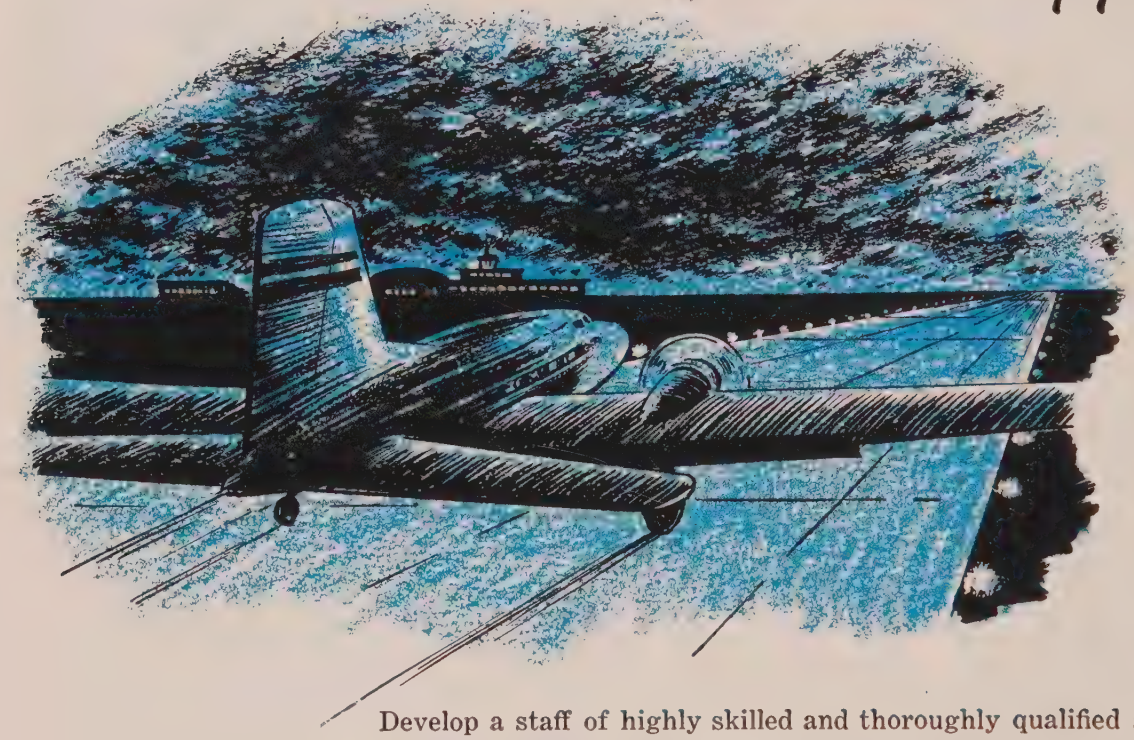

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pilot to fire the bottles. I would like to mention an amusing incident which has to do with San Jose, Costa Rica. That's when we had the 'Old Smoky' Jato. We took off from San Jose with a temperature of 95°, and fired the bottles as soon as we got up to 80 mph. The next thing we knew we were up in the air with our wheels up at half the runway length. We had informed the tower that we were going to fire Jato, but evidently they didn't understand what we were talking about. The next thing we knew, there was the darndest screaming in Spanish you ever heard. We had blanketed out the complete airport. In view of the fact that there was no wind, there was just one solid mass of smoke, and it stayed that way as long as I could see after I took off. However, with the new bottles we don't have that problem.

"With the Convair, in our certification tests for Jato at Brownsville, Texas, we fired the four bottles sequenced in pairs with an eight second overlap, with the full gross load and with one engine pulled back, at V_1 speed, about 115 knots. We went right on out as though nothing happened. We asked the tower how the take-off looked, and they said, "It looks like a normal take-off." But they didn't know we'd had an engine pulled back. On the next take-off we did the same thing, with an engine pulled back, and went straight on out. So, I think it's darned good insurance.

"I would like to find a way, if possible, to stop the after-burning of the residual propellant padding materials so that I could dump gas within a reasonable length of time after firing the Jatos. I wondered if there isn't some kind of device, possibly spring-loaded or something, that would stop any after-burning."

Rice: "We are now running some tests in this category, and have run tests in the past. Raw gasoline has been sprayed on the Jato when it is ignited, with no ignition of the gasoline. However, we don't advise doing this in practice. The after-burning flame is not a hot flame, and extends only a few inches from the nozzle. Therefore, it is no worse than the exhaust of your engine. Considering the location of the fuel dump chutes on your Convair, you should have no problem."

Estelle: "I just wondered if there isn't something that could be done. Really this is no complaint, you understand; I am just touching on a problem that would give me a little more confidence if I did want to dump fuel after using Jato."

Dolinski: "We've fired them, and made a circle of the field, and found that you could put your hands on the bottles. I think it's really just smoke; I don't think there's any serious problem."

Estelle: "There's a little afterburning flame, for a matter of 15 seconds or so. I mention it because, if you were at high altitude, and had a full gross, and lost an engine, you might wish to dump fuel and be hesitant to do so. However, I still carry the bottles, regardless of that."

Dolinski: "I don't think that it would give you any more trouble than your normal exhaust carbon that could come from your engines."

Swearingen: "I'd like to point out that the CAA requirement for fuel dump systems requires that no fuel be allowed to touch the airplane after it leaves the dump chute."

Estelle: "Just a couple of months ago in New York there was an LAV Constellation lost while dumping fuel."

Dolinski: "Have they determined what ignited it?"

Estelle: "An Eastern Airlines plane was flying beside it, and apparently the Constellation wasn't going fast enough, for one thing. The Eastern pilot told him to get his speed up. You have to dump at certain speeds, I believe its 160 for DC-6's, isn't it?"

Putnam: "*With a constellation it's 260; with a DC-6 there's a maximum, but no minimum.*"

Estelle: "In a Convair, its 140 maximum. If you have that speed everything is fine, but you have to be sure of that."

Putnam: "*I believe I would think twice before dumping fuel immediately after the Jato has been fired.*

"*Mr. Rice, I have a question for you concerning thrust. How much actual thrust do you realize from these rockets under conditions of high temperature? And what is the effect of higher altitudes on this thrust?*"

Rice: "Actually, at higher temperatures, you get not only higher thrust, but also a higher total impulse. This is the converse of the effect on a normal engine, and it results from the fact that the operation of a rocket depends upon its burning rate, and its burning rate is faster at higher temperatures because it does not have to be heated so far to reach auto-ignition temperature. The total impulse is greater because there is not as much energy expended in raising it to auto-ignition temperature. At higher altitudes it also develops more thrust because it carries its own oxidizer, or oxygen supply, and since there is less air resistance at higher altitudes, the thrust is slightly greater. Rocket engines have built-in temperature and altitude compensation. We have a report on the operating characteristics which we would be happy to send to anyone who is interested."

Putnam: "*In other words, the greater the altitude, the better it works.*"

Estelle: "What equivalent horsepower am I getting on my Convair at V_2? According to the chart I have, it looks like you've got about 475 or 500 hp out of it."

Rice: "At 100 mph, you get 450 hp, approximately. The thrust in equivalent horsepower output of a normal DC-3 propeller-engine combination is the equivalent of about 350 hp before the airplane starts to roll, and that goes up to about 560 hp when you get up to about 140 mph."

Putnam: "*Mr. DeVore, you've had quite a bit of experience in the engineering and flight test aspects of aviation. Would you like to tell us a little bit about your views on the problems associated with drag and installa-*

tion of these units, the openings that they make through the skin, or the external mounting; and also something about the installed weights and the advantages gained by the extra thrust, and finally the advantages in terms of added weight."

DeVore: "As far as the drag is concerned, an external installation, like any item of equipment which is installed externally on aircraft, will produce drag, depending on where it's located, and how it's mounted. The nature of Jato is such that they are usually installed below the fuselage near the center line, and for the normal low wing airplane the drag increase in this combination has been shown to be negligible. On a high-wing or mid-wing aircraft, this may not be true. The only place where the drag might be considered a problem, however, even on a high-wing plane, would be in the en-route climb of the airplane, and, to date, tests show that this drag effect has been negligible on Aerojet's DC-3 and Esso's Convair."

Domning: "In connection with the drag that you were talking about, we conducted low- and high-speed tests on the DC-6. We were concerned with drag in the en route configuration. The reduced data points from those tests fell within the scatter of the original Douglas flight-test points. We felt we could not distinguish Jato drag from the overall drag of the airplane."

Putnam: "*Then you would say it is negligible in that particular airplane.*"

DeVore: "That then confirms our experience too. As far as internal installations are concerned, there is no drag problem to be considered. The installations are made so that the temperature from the exhaust pattern clears the structure and the skin, and the original contour is retained.

"Weight credits and performance are a big area. The CAA and the Board have both considered the reliability of Jato favorably to the extent that they are now willing to allow some performance credits. This has been done previously in limited cases, for people such as Braniff and Panagra at La Paz. However, on a general across-the-board basis, they are now beginning to take action and allow performance and weight credits. The Board is considering the larger scale performance credit for Jato, and right now it is incorporated in a proposed set of transport category regulations which will be reviewed shortly at the Annual Review. In the meantime, CAA has developed an interim policy permitting weight increases within the structural limits for the weight of the installed Jato. In addition, they have granted runway length reductions in accordance with the amount of Jato installed as related to a percentage of take-off power available.

"I want to quote some figures to give you an idea of what Jato can do. This is based on a two-bottle installation on a DC-3 operating at a 6000-foot airport. A DC-3 at 26,900 pounds could gain an altitude of 300 feet above the take-off surface, after losing an engine at V_1 with Jato, in 2600 feet less distance than that required if you took off at 25,200 pounds without Jato. The CAA policy does not allow credits approaching this degree, but within the limitations of the airplane structural gross weight, their policy will definitely provide benefits to the operator in terms of gross weight and take-off distances."

Putnam: "*Mr. DeVore, as long as you're familiar with the engineering aspects of this operation, could you give us some indication as to the effects of acceleration on the aircraft control? Is there any problem? Is any of the thrust off-center to the extent that it would become a problem?*"

DeVore: "Well, I can't answer that completely; I'd have to refer that to one of the pilots. From an engineering standpoint, however, a Jato installation inside the engine nacelles can have no detrimental yaw effects on the airplane since the airplane is in the first place satisfactory in yaw with one engine out. Other than that comment, I'll have to defer to one of the pilots on smoothness and so forth."

Estelle: "I can answer that. I've fired a bottle several times, and never noticed a bit of yaw at any time, even with one engine out. If you hold the airplane straight, even with one engine it's not going to effect it in any way that I can see."

Domning: "In our test program at La Paz and in subsequent pilot training, we fired possibly 30 bottles on the DC-4, and we trained about fourteen pilots. No pilot had any unfavorable comment to make whatever upon the effect on the characteristics of the aircraft, and I can say from my own experience that the only thing you have to do is to keep from building up too much speed if you want to get the altitude benefit."

Putnam: "*How many bottles did you fire on the DC-4?*"

Domning: "One at a time."

Putnam: "*Did you have space for two?*"

Domning: "We had four bottles on the airplane, but we fired one at a time normally, and for test purposes we fired two consecutively because our performance is based upon that. In training we fired only one bottle with each pilot.

Rice: "Am I correct in saying that these bottles were mounted on the center section of the wing, with a spread of about ten feet, five feet on each side of the center line of the airplane?"

Domning: "That is about right. That was the extreme spread."

Dolinski: "In our DC-3 installation, which is near the center line, I have fired the bottle on the same side as we had the good engine; in other words, pulling back the left engine I would fire the right bottle, giving us thrust of the engine on the right side and the bottle on the right side, and of course we have done just the opposite, fired the right engine and the left bottle, and there isn't a noticeable difference."

Putnam: "*In other words if there is confusion between which bottle is to be ignited, it wouldn't make any difference.*"

Dolinski: "I don't believe so. My experience has been that I can hardly tell which bottle is firing, except that I know I've got thrust, and by checking the switch you feel you know which one is on."

DeVore: "I believe that Col. Estelle probably has the extreme spanwise installation here, that is, having a bottle in each nacelle. If he were to lose an engine, and were to fire the bottle on the good engine, that would be the extreme. I wonder if in your firing Jato you feel that this would present a problem in handling the airplane."

Estelle: "If we lose an engine we're going to fire both bottles; we have them wired that way, so there wouldn't be any mistake at a time like that. I don't think, on a Convair, with a ship as heavy as that, that you'd want to gamble on firing one bottle; I don't think it would pay."

Putnam: "*Mr. Rice, you've got a question here.*"

Rice: "Continuing just one moment on Col. Estelle's statement regarding firing one bottle, Ethiopian airlines had bottles mounted on the belly of their Convair, and they fired one at a time, and found it to be most satisfactory. It gave them adequate thrust to far more than meet the climb requirements in the high temperatures and altitudes in which they were operating with heavy loads. However, Mr. Dolinski has had some experience in firing bottles at altitude with application of normal power simultaneously.

(*Continued on page* 49)

nu-avi-quip

Lightweight "Hot Papa" Suit Ideal for Small Fields

Small operators and service operators not based on large municipal fields generally rely on or participate in volunteer fire and crash-fighting programs. Their employees' willingness to engage in hazardous life-saving activities is easily influenced by the available self-protection equipment and the probability of their efforts being successful.

The familiar bulky, heavy, uncomfortable asbestos "Hot Papa" suits of large field professional crews are rarely practical economically or physically for the smaller operations. Minnesota Mining & Mfg. Company have demonstrated a suit made of aluminum-coated fabric that reflects radiant heat instead of insulating against it.

It enables a fire-fighter to walk into and manipulate necessary fire-fighting or rescue equipment, a fire with temperatures in excess of 1200°. In demonstrating the suit, 3 employees have carried arms full of wood, bundles of steel wool, etc. which promptly burst into flames. They have stated that no radiant heat gets by the reflective coating and underlining of glass wool.

High Visibility Fluorescent Paint Safety Factor for Business Planes

Switzer Bros., Inc., Cleveland, Ohio, have introduced a new aid to minimizing the growing hazard of aircraft collisions, Day-Glo high visibility fluorescent colors, a daylight-fluorescent paint which emits light, which is up to four times as bright as ordinary paint and which is visible at much greater distances.

The advantages of the new Day-Glo paints, now being offered to aircraft manufacturers, air carriers and airport operators, have already been proved in use on tow targets and jet tow planes, and in the location and rescue of two lost aircraft of the Byrd Antarctic expedition.

CAA tests indicate that Day-Glo colors have more resistance to weathering than International Orange, and that even after ten months' exposure are visible up to four and a half times as far as International Orange.

The use of these high-visibility fluorescent colors suggests itself as one reliable and comparatively inexpensive way for the business pilot to help relieve the hazardous situation created by the continued use of inadequate visual flying regulations.

There is a great number of color schemes and overall paint applications on current aircraft where the use of Day-Glo paints would equally enhance the attractiveness, safety, and "attention-demanding" aspect of the aircraft.

Republic Dual Hydraulic System is Lighter, Cheaper, Safer

A simplified tandem hydraulic-powered actuator system for aircraft primary flight controls, with two completely independent systems, each with its own tank and associated plumbing, but which costs and weighs much less than earlier systems, has been developoped by Republic Aviation Corp., NBAA Associate Member, Farmingdale, N. Y.

The new system, which is immediately intended for the military, is readily adaptable to business aircraft. It has a great intrinsic safety factor because complete hydraulic failure anywhere in one system will not affect proper operation of primary flight controls. In addition to the safety factor, the lighter weight of the new system and the ease of operation, which is so great that the pilot would feel no difference in the controls in the event of a failure in one system, suggests that the new Republic tandem system is ideal for the requirements of business flying.

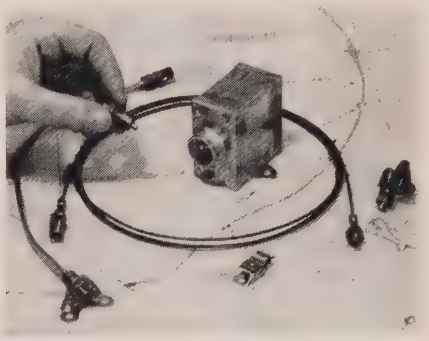
Fire Detector Gives Classified Warning

A new fire detection device for aircraft which will give an immediate nacelle overheat signal reporting potential danger and secondly, a fire alarm should that condition develop, has been produced by Walter Kidde & Co.

Operating on both the fixed temperature and rate-of-temperature-rise principles, the detector consists of two units, a fire sensing element and a control unit. The control unit employs transistors which interpret electrical signals from the sensing element.

Knowing the normal operating temperature range within a given nacelle, the control unit would be pre-set to be on standby until an abnormal temperature is reached, even if the temperatures mount slowly as in the case of overheat.

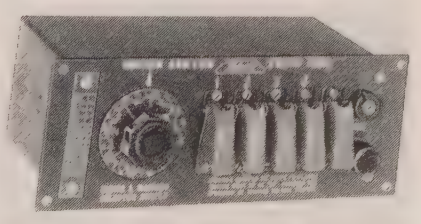
In case of fire, where the rate of temperature rise is rapid, there is a rapid rate-of-resistance drop in the semi-conducting insulator and a fire alarm is triggered. Also a fire resulting from overheat will over-ride the overheat signal and flash a fire alarm. Fire detection response is under 5 seconds and two units weigh only 3 lbs.



Bendix Portable Ignition Analyser

Of special interest to business fleet operators, and even some operators of single large aircraft, will be the announcement of Bendix Aviation's portable ignition analyser.

In preventive maintenance alone, the economies and safety offered justify serious consideration. The analyser can be obtained also in a configuration for airborne mounting and in-flight use, or the panel units can be mounted in several aircraft so that successive and periodic use can be made of the analyser on a scheduled basis.



Self-Sealing Rivets for Fluid Tight Fastening

Mass production of unique rivet fasteners which automatically seal them-

selves against fluid or air leaks without caulking or rubber sealing agents, have been announced by Pastushin Industries, Inc. Especially suitable for use in such structures as integral fuel tanks, external tanks, and in particular amphibian hulls, seaplane pontoons, etc.

The Pastushin rivet attains its leakproof seal from a soft aluminum jacket or sleeve around its shank which extrudes, or flows, when the rivet is expanded after driving. They are manufactured for use with both automatic riveting and hand riveting operations.

New Cylinders Solve Overheating

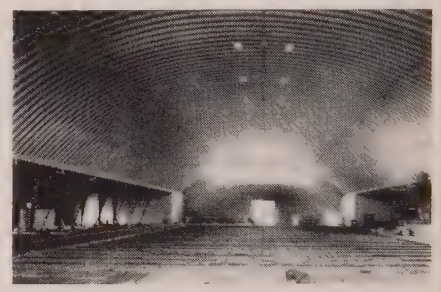
Jim Magnus of Minneapolis-Honeywell Regulator Co. (NBAA member), operating two DC-3's, reports as follows:

"A pilot's dream has finally been realized regarding the excessive cylinder heating problem that has existed on the R-1830-92 engine. Gopher Aviation, at Rochester, Minn. [NBAA Associate member] has mounted 'Dash 94' cylinders to our R-1830 engines, eliminating our overheating problem. In addition, they have installed a high-capacity oil pump. This has substantially reduced our climbing temperatures; our cruising temperatures are reduced from 210° to about 165° or 175°. This is all accomplished by the increased cylinder fin area and more efficient baffling. The other pleasing factor is the comparatively moderate cost of this changeover. Over the normal overhaul charge, it cost us about $1200 to include this safety factor."

New Steel Roof Spans 120 Feet Without Interior Support

A pre-engineered steel roof for aircraft hangars, capable of spanning 120 feet without support, of withstanding winds in excess of 113 miles per hour and of supporting the equivalent weight of 5½ feet of snow, has been made available by the Wonder Building Corp. of America, Chicago, Ill.

The new "Wonder Roof" is made of 18-gauge galvanized corrugated steel sheets two feet wide and from six to ten feet long, bolted together into a self-supporting arch.

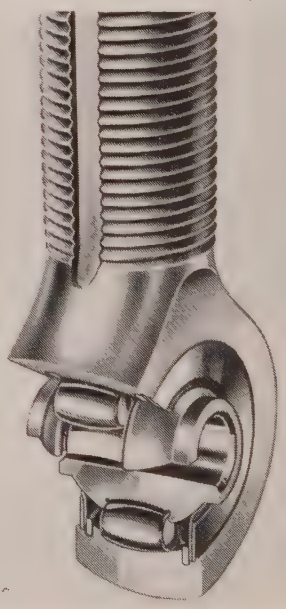


"Balanced Design" Control Rod Bearings

A completely new series of rod end control bearings for aircraft now being manufactured by The Fafnir Bearing Company, New Britain, Conn., incorporate a significant new balanced design, the direct outcome of an NASC study in which Fafnir engineers participated.

The new rod end comes in five sizes with every member of the series designed so that bearing capacity, shank strength and bolt strength are in balance. The series consists of standard sizes which meet a wide range of requirements for antifriction rod ends.

Within the family are both ball and roller bearing rod ends with male threaded shanks. The two ball bearing rod ends with high strength shanks are designed primarily for manually operated control systems. Completing the series are three high capacity roller bearing rod ends for power-operated flight control systems.



Skyways Round Table

(*Continued from page 46*)

Dolinski: "In a fly-by firing we slowed the airplane down to 120 mph and came across at about 15 feet, and applied power just before we started the gear up and fired the bottles. At climb power we went to 180 mph at 2500 feet a minute climb. I didn't expect to go quite that high or that fast."

Putnam: "*Mr. Swearingen, so far all of our conversation and experience dealt with larger aircraft; what is your estimate of the applicability of these to the smaller, lighter twins?*"

Swearingen: "Well, certainly, standby thrust would enhance the operation of these little planes as well as the larger. The smaller 250-pound thrust bottles, when they're available, will probably be more the proper size, for aircraft such as the Aero Commander. The 1000-pound thrust bottle would have too much thrust-more than the one engine you have missing. I am actually more familiar perhaps with the use or intended use of this Jato on executive aircraft of the Ventura size, which we manufacture. I have some figures here that I might give you in rate of climb with and without Jato in various single-engine configurations. Our first segment rate of climb at 29,000 pounds gross without Jato and with the gear down, right after takeoff, is 205 feet a minute. With Jato, this goes up to 886 feet a minute, which is pretty respectable single-engine rate of climb. With gear up, we have a basic rate of climb of 413 feet a minute, single engine; with Jato this goes up to 1000 a minute. At 4000 feet it doesn't change a great deal. We drop down on our basic rate of climb of 324 feet a minute without Jato and go up to 1005 feet in a minute with Jato. In short field operations, you have to more or less count on the engines, and I think that with Jato you're in a good position, because you can approach normal two engine performance, even if you do have engine failure either landing or taking off."

Putnam: "*Mr. DeVore, in the course of your engineering services, are you aware of any general contemplation by the manufacturers of providing Jato?*"

DeVore: "Off hand I'd say that Mr. Rice would probably be more familiar with that than I would; but certainly there's no question in my mind, having worked with flight test for a long time, that the advantage of standby thrust from the safety standpoint is something that the manufacturer should not overlook. I spent a good deal of time in the CAA working with helicopters. I might say that I think there's a great future in the application of Jato to helicopters. One of the critical areas in helicopter flight operation is in hovering, where a lot of power is required, and under high temperature and altitude conditions both the engines and the rotors are effected, so there's a wonderful possibility here for Jato serving as standby or, as its name implies, a jet assist takeoff to get out of this hovering range."

Estelle: "You mean translational operation?"

DeVore: "Yes, going into forward flight."

Estelle: "Because we have a number of operations in hot climates with helicopters, in fact one of our affiliated companies is operating out of New Guinea, which is a pretty hot climate, and I wondered if anyone had actually tried Jato on helicopters."

Rice: "Yes, there have been some trials of Jato early in the helicopter field, however, more recently, this has not been done; all of the applications have been military, and there is further consideration being given to the application of Jato to military helicopters at this time. There are also further considerations being given by some of the helicopter manufacturers, and we are working with them along this line, but we need to have the 250 pound thrust unit so that we can install it in multiples in helicopters. We have also designed a rocket turbine rotor-booster for helicopters, but this has not been put into use to date. I'd like to add that there are two light-twin manufacturers anxiously awaiting the Junior Jato so that they may make optional installations at their factories. We have some single engine manufacturers also considering the same thing. The Junior Jato will be applicable not only to the light twins but also to single-engine airplanes to permit them to get over an obstacle in case of engine failure or some other unforeseen condition."

Putnam: "*When do you anticipate that this Junior version of the rocket will be available?*"

Rice: "We anticipate that we will have it certificated and in production before the first half of next year."

Putnam: "*Well, Captain Domning, to get back to the psychological effects of this on both the crew and passengers, you've probably had more experience with it than anyone else. Has your company noticed any such effect on passengers. We assume the crews are no problem because they've had training. But has the company become aware of any reluctance on the part of passengers to ride with Jato? Is the smoke or the noise any problem?*"

Domning: "When we initiated service using Jato, we gave it a great deal of publicity in the places it was going to be used. We conducted a number of courtesy flights for officials and newspaper people to make sure that the problem that we were confronted with would receive a pretty good airing as far as the public was concerned. As a result we had a completely satisfactory reception from the passengers. We never had anybody express any concern over flying in an airplane with Jato. Of course there is another element of psychology involved, and that is the concern that the passenger may have during the actual firing of Jato. We checked that out by taking a group of these laymen in the airplane, making the takeoff at La Paz and firing Jato at V_1 to give them the full benefit of any noise that there might be. Some of them did have some comment and said that

it sounded as though a few more rocks than usual were hitting the belly of the airplane, and that's about all they could say."

Putnam: *"Have your company officials riding in company aircraft been startled by your use of Jato when they didn't anticipate it?"*

Estelle: "No, because they were educated in the fact that we were going to fire the bottles and they said they were happy to know we had extra power. They could hear that screaming of the bottles on the take-off; that's actually what happens and you do hear it. They've been very pleased about it, because they have noticed the tremendous difference in takeoff, especially at high altitude."

Putnam: *"Well, Mr. Rice, speaking of noise, do you contemplate that the Junior version will have a noise level equivalent to that of the large? In other words, one-fourth? Or will it be greater than that, and do you think there's any possibility it will become a noise problem around airports and congested areas?"*

Rice: "Actually, we do not anticipate and have not met with any noise problem at all, because the noise of the larger Jatos that we have are about the equivalent to a T-33 taking off. We have fired them at Los Angeles airport, without anybody even knowing that a Jato takeoff had occurred. The noise level is not that which would be associated with the larger jets, that everybody is worrying about at this time."

Putnam: *"Mr. Rice, is there any possibility of freezing slush affecting these bottles on a takeoff; their ignition?"*

Rice: "As far as the operation is concerned, we have had no problems whatsoever, Mr. Dolinski can attest to the fact that the Jatos which we have had have been subjected to the worst rain conditions and when inspected, after 502 hours of carriage under the airplane, exposed to the elements, which included blowing sand as well as water and everything else, the Jatos were in exactly the same condition as they came out of the factory. As far as that is concerned, perhaps Col. Estelle would like to make some comment. I'd like to make one other point, and that is that there has been discussion by some pilots in the East who are somewhat concerned about the amount of ice that these bottles might collect in ice and water. Perhaps Col. Estelle has had some experience with that."

Dolinski: "We flew with them in ice last winter. I feel that it's no more of a problem than an exposed ADF. I'd say that we picked up a similar amount of ice."

Estelle: "I believe that there are no more difficulties with the bottles than an ADF loop because your ice would streamline itself on the front of the bottles, so that it wouldn't affect it in any way. And that's true of your ADF; they'd build up some ice around them, which may slow you up a mile or two an hour. But if you're in that much ice, you want to get out of it pretty fast anyway. At least I do."

Dolinski: "To go back to the amount of drag that we've experienced, we ran tests with and without bottles, and we even left the large handling rings on, which are about 10 inches in diameter. We found that you couldn't tell the difference between no bottles, and the bottles with the ten inch ring on them."

Putnam: *"Well, Mr. Rice, to get back to smoke and noise and that sort of thing, one that struck me might be of considerable interest to the operator using these units in relatively small airports surrounded by residential areas, is there any residue from smoke that could do damage to laundry? We get complaints every now and then about engine oil ruining Mrs. Murphy's laundry and things like that. I just wondered if the users of these rockets would extend themselves to paying for someone's laundry."*

Rice: "I think the best answer to that is that the houses are now built right up to our door, and we are running tests on all sorts of rockets constantly. We have had no complaints from our neighbors so far as the laundry is concerned. I might add too that when we speak about these rockets being smokeless, we mean relatively smokeless. Actually in dry humidity they are almost completely smokeless, except for the smoke that is emitted at the end of the duration of the rocket as the result of the burning of the residual materials. However, this dissipates itself immediately. In cases of high humidity, they will emit about as much smoke as a rich burning reciprocating engine. But this again dissipates itself and is not nearly as much of a smoke trail as is left by a jet with water injection."

Putnam: *"Mr. Swearingen, there is one thing that bothered me a little, and that is that these bottles hung under the center section or beneath the belly of a small airplane creates a possibility of disastrous damage to the structure in case of a belly landing—I know we don't contemplate doing that but, unfortunately it happens quite often. Would you like to talk a little bit about the consequences of an inadvertent wheels up landing?"*

Swearingen: "The people that install Jato under the belly of the airplane have taken wheels up landing into consideration, and have designed purposely to have the Jato detach itself at first impact. It would be highly desirable from a structural standpoint as well as any remote possibility of a fire coming out, to have it come off at the time the airplane contacts the ground —leave it back there someplace."

Putnam: *"In other words there is no possibility of the thing getting tangled up in there and creating a disaster? I wasn't thinking of a fire but of structural damage."*

Swearingen: "It isn't always easy to predict what will happen, of course, in the matter of a belly landing, but certainly if the hooks are designed properly, the thing can come off very easily due to reverse thrust loading such as it would have dragging on the ground in the event of a belly landing."

Rice: "May I further comment in this regard that all installations are done in accordance with design criteria that has been approved by the Civil Aeronautics Administration. This design criteria requires that in externally mounted Jatos, they be mounted with hooks that are so designed they drag off readily. I think a typical example of this is that the hooks are designed for a load limit of 4850 pounds in forward thrust while they are designed for a drag off load of only 350 pounds. An engineering report on the design criteria is available to anyone who is interested."

Devore: "On this same subject I might mention that in the internal installation we are designing for crash load factors, so that if you have an internal installation and are forced into a landing of that same type, the installations are thoroughly designed for safety."

Putnam: *"It's a pretty important problem, I think, because a great many of the business aircraft are not being flown by professional pilots, and an inadvertant wheels up landing is certainly not beyond the realm of possibility, and damage resulting fom that could be a very significant factor I think in the decision of whether or not to put Jato in the airplane. Operating from large fields he wouldn't have to worry too much, and yet if he has the bottles hanging out there he could do himself a terrific amount of damage if they're not properly installed. Would you like to comment on that a little more?"*

Rice: "This has been a prime consideration in the development of the external installations of Jato, and it is realized that it is a matter to be considered. The value of Jato, however, for takeoff or throughout the flight is so great that it becomes insignificant rather than a significant factor as compared to the protection that you receive. Yesterday I was talking to a pilot who was telling me of an accident which occured in one of our major airports when an airplane on the approach hit a down draft at the end of the runway and wiped off the landing gear. It did a considerable amount of belly damage on the runway. This airplane was coming into an airport which is built with a sharp drop off at the end of the approach runway. With a strong wind blowing there was a sharp down draft at the end of the runway. This is also true of several other airports around the country. It is quite interesting to note that more accidents in both civil and military aviation have occured as a result of undershooting on landings than from any other primary cause. It is certainly a comforting thing to have some additional thrust to pull you on in to the runway when you are running out of altitude at a very rapid rate. You must remember that the climb is critical in this case with the flaps and gear down. The rate of climb is entirely based on the amount of excess thrust over that which is required to carry the airplane in level flight. Consequently, you do not have to add very much thrust to make a very significant change in the rate of climb."

Putnam: *"Something that is almost certain to be a problem to the typical owner is the cost to him in terms of the weight of these bottles in proportion to total useful load of business airplanes. And of course the dollar value as well. Now the relative cost of a Jato bottle in the DC-4 is probably rather small—but when you have a smaller airplane such as an Apache, probably the cost of the bottle in terms of the dollar value and its loss in payload adds considerably to the cost of the airplane?"*

Rice: "On the average it is anticipated that the cost of carrying rocket standby engines on any of the smaller aircraft will amount to perhaps something less than 1½% of the value of the airplane annually. This is pretty inexpensive insurance. We are now discussing with some of the insurance companies the possibilities of reducing insurance rates in recognition of the increase of safety with the Jato thrust. We still have considerable amount of work to do in this direction. However all of the experience to date is good, and we expect to be able to gain recognition on this point eventually. The weight of installed Jato on the light twins is only 1% to 2% of the gross weight of the aircraft. After it is fired, only about ¾% to 1% residual weight remains.

Swearingen: "On our own airplane, the Super PV-1, we can amply carry the additional weight of the Jato. Although our two bottle installation weighs approximately 340 lbs. installed, it reduces inweight by about 144 lbs. on firing because of the burning of the propellant. So the weight problem under emergency conditions is not very

Round Table

(*Continued on page* 56)

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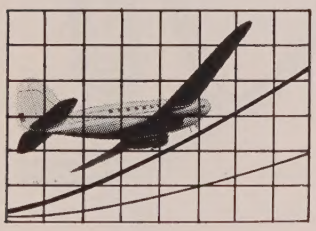

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AERO CALENDAR

Oct. 7-9—American Helicopter Society western forum; Adolphus Hotel, Dallas.

Oct. 8-10—2nd annual symposium on aeronautical communications, sponsored by IRE; Hotel Utica, Utica, N.Y.

Oct. 10-12—SAE National Transportation Meeting; Hotel New Yorker, N.Y.C.

Oct. 10-16—NACA triennial inspection, Langley Aeronautical Lab.; Langley, Va.

Oct. 15-17 — Radio-Electronics-Television Mfrs. Assn, radio meeting; Hotel Marrott and CAA Technical Development Center, Indianapolis.

Oct. 22-26—National Safety Congress, Chicago. Aeronautics conferences Oct. 22 & 23.

Oct. 23-25—NBAA 9th Annual Forum; Hotels McAllister and Columbus, Miami.

Complete program information for the NBAA 9th Annual Forum, including a map of Miami and a list of panel discussions, will be found on page 26 of this issue.

Oct. 25-26—Aircraft Electrical Society, annual equipment display; Pan Pacific Auditorium, Los Angeles.

Oct. 29-30—3rd annual East Coast Conference on Aeronautical and Navigational Electronics, sponsored by IRE; 5th Reg. Armory, Baltimore.

Nov. 8-9—National fuels and lubricants meeting, SAE; Hotel Mayo. Tulsa.

Nov. 14-15—Aircraft Industries Assoc., export conference; Miami Beach.

Nov. 25-27—Aircraft Dealers & Mfrs. Assn., 28th meeting; Drake Hotel. Chicago.

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NBAA Membership

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Membership in this non-profit and independent aviation organization is based on the recognition of business flying problems common to all users of aircraft for their business purposes and to those engaged in supporting the operation, servicing, equipment, and manufacture of business aircraft.

Among the fields in which NBAA is concerned are: improvements in airways and airports, better weather service, expansion in communications and air navigation facilities, higher standards of airport services, improved aircraft parts distribution, equitable tax rulings for business aircraft operations, greater recognition of the airplane as a necessary tool in modern business and industry, better air traffic control procedures, professional status for qualified business pilots, and aircraft designed to meet the special requirements of business flying.

in the business hangar . . .

(*Continued from page* 40)

■ Executive Aircraft Service, Inc., recovered the elevators and completed miscellaneous minor repairs on the DC-3 flown by O. E. Sparks for Holley Carburetor Co., NBAA member, Detroit. □ The Dow Chemical Company, Midland, Mich., sent their DC-3, piloted by Russell Purchase, to Executive Aircraft Service for an engine change and minor repairs.

■ Executive Aircraft Service, Dallas, completed inspection, modifications and miscellaneous repairs on the DC-3 flown for Esso Shipping Co. by Bob Eick. □ Seaboard Oil Co. brought their DC-3 to EAS for 100-hour inspection and repairs.

■ Pacific Airmotive Corp., Burbank, has announced long-term contracts covering the overhaul of engines on the DC-6's of The Flying Tiger Line and Slick Airways. The new agreement is in addition to PAC's present overhaul contract on DC-4's operated by both carriers.

■ Van's Air Service, Winona, Minn., has just completed ten-day training for multi-engine rating for three persons who purchased an Aero Commander from Van's. □ Radio equipment was installed in DeKalb Agricultural Assn.'s Aero Commander, Hugh McCorkle, Chief Pilot. □ Norm Silver brought Majestic Contractors' Aero Commander to Van's for engine change. □ Van's Air Service has just acquired distributorship for the Temco Riley Twin for N. and S. Dakota, Iowa, Wisconsin and Minnesota.

Round Table

(*Continued from page* 51)

great since the residual weight in relation to airplane gross weight after firing is only ¾%. Under normal conditions, of course, it isn't important. Also the CAA will approve an increase in the gross weight to cover the weight of the installation, limited only by structural or en route climb limitations. From the cost standpoint and acceptance from the psychological standpoint, we normally have eight airplanes in manufacture at a given time in our assembly line, and six customers of those eight have already signed up for Jato and the other two are seriously considering it only six weeks after we first made Jato available as optional equipment."

Rice: "The cost of installation on the average aircraft comes somewhere between two and four percent, depending on how involved the installation is. This includes the Jato units that are necessary to check out the installation and pilot, and those which will be carried on the airplane for the first year. Further, since the units are definitely usable each year they are deductible as an item of operational expense against the aircraft, whereas the installation itself is a capital investment item."

Putnam: "*What are the requirements for periodic inspection and maintenance, and what special handling is required?*"

E. J. SWEARINGEN *(l) and G. E. Rice discuss flexibility of modern Jato. Swearingen reports great success with Jato-equipped Super Venturas; Rice describes application of Junior Jato to smaller business aircraft.*

Rice: "Inspection is required every 100 hours as is also required on the aircraft. Only a few minutes is required for this inspection, since with the igniter removed you can readily look through the Jato.

"The only maintenance required would be that normally required on any electrical system and any fixed structure of the aircraft. No new maintenance problems are created.

"The propellant of the standby rocket engines is very stable. It has a thermo-setting plastic base and, therefore, cannot generate inflammable gasses or leak inflammable materials. It requires 600 F continuous heat for ignition. Consequently, it can be handled much more safely than the fuels normally used in aircraft or many other inflammable materials normally used around aircraft. However, because it is a high energy fuel in a pressure vessel, it requires shipment by properly certificated common carriers. We have a report describing its handling characteristics in detail which we would be happy to supply to interested parties."

Putnam: "*What precautions are being taken against inadvertent firing?*"

Dolinski: "We ground our Jato electrical leads when our plane is on the ground and reconnect them when we are ready for flight."

Estelle: "We have, in addition to our regular switches a circuit breaker, and we keep those out all the time; the only time that those are pushed in is when we're on the end of the runway ready to take off, so that gives us a double check on whether they can be fired."

Swearingen: "On the SuperVentura installations, we have a key-operated arming switch, so that the crew can have any degree of security they desire, all the way from having only authorized pilots with keys to keeping the key in there and trusting their people that are on the airplane. I think most pilots are going to confine the use of Jato keys."

Rice: "The CAA approved installation design criteria requires that all firing switches be spring loaded momentary contact type and in addition to key lock or other precautions just mentioned that warning lights be connected to the arming switch."

Putnam: "*To get back to this maintenance problem—you have probably fired more of these than anybody. Have you run into any skin corrosion behind these rockets?*"

Dolinski: "In our tests and flight demonstrations, I believe I have fired approximately 19 or 20 of these bottles. In our first half-dozen firings, we had temperature indicating paint, and found absolutely no heat problem. From the corrosion standpoint the only thing we have done is to wash the belly down after firing. We have watched this very carefully and have had no indication of corrosion problems at all."

Putnam: "*In other words simple, normal precautions. How about you Mr. Estelle, have you had trouble?*"

Estelle: "None at all. In fact we don't bother to wash the airplanes after we fire them and never as yet experienced any difficulty with the paint on our airplanes."

Dolinski: "This was the thing that I was going to say, that we washed them the first two or three times and have neglected to do it ever since."

Estelle: "It isn't a question of neglect—we found it wasn't necessary, so why do it?"

Rice: "The wash down procedure after firing should be used on unpainted aircraft used in salt water areas to preclude the possibility of any corrosion."

Putnam: "*Last, but not least, of interest to everyone is the availability of installation of these rockets.*"

Rice: We and our distributors are working along with many modification centers and we will be happy to assist any approved repair station in making installations." +++